Human Capital, Labor Markets and Remittances in Francophone Sub-Saharan Africa:

An Analysis of Education and its Impact in Senegal

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List of Acronyms

2SLS	Two-Stage Least Squares
ATT	Average Treatment Effect on the Treated
CIA	Conditional Independence Assumption
CONFEMEN	Conférence des Ministres de l'Éducation des pays ayant le français en Partage
CRES	Consortium Pour La Recherche Économique et Sociale
EFA	Education for All
FDI	Foreign Direct Investments
GDP	Gross Domestic Product
IV	Instrumental Variable(s)
MDG	Millennium Development Goal
NGO	Non-Governmental Organization
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PASEC	Programme d'Analyse des Systèmes Éducatifs de la CONFEMEN
SUTVA	Stable Unit Treatment Value Assumption
UIS	UNESCO Institute for Statistics
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
WLE	Weighted Likelihood Estimation

1 Introduction

Key figures of education in Sub-Saharan Africa have improved substantially in recent years. From 2002 to 2012, the rate of out-of-school children of primary school age has decreased from about 36 percent to about 22 percent, the gross intake ratio to the last grade of primary education has increased from roughly 57 percent to almost 70 percent and the adult literacy rate of the population aged 15 and above has increased from about 57 percent to almost 60 percent (UNESCO, 2014a).[1]

Nevertheless, the level of educational attainment is still low and has considerable scope for improvement. One of the important limitations to quantitative and qualitative improvements in education systems of developing countries is the severe budget constraint they face. The construction of schools, teacher salaries and the provision of teachers' professional education are some of the main expenditures of governments for their school systems.

In low income countries, there are also often severe financial constraints on the micro-level. Households may need their children to help generating household income (see, for example, Patrinos and Psacharopoulos, 1997, p. 398). The latter can help in agricultural or in commercial activities and may therefore be partially absent from school. Schooling may consequently be subject to opportunity cost considerations: The benefit or return of an additional year at school may therefore be weighed against the immediate gains from working (see, for example, Bedi and Marshall, 2002).

[1] These figures by the UNESCO Institute for Statistics (UIS) are partially estimated.

Introduction

The financial constraints of governments on the macro-level and those of households on the micro-level play an important role in motivating the research question in chapter 2: There, I analyze grade repetition of students – a phenomenon that is particularly strong in Francophone Sub-Saharan Africa. Around the year 2000, repetition rates in primary education in Francophone Sub-Saharan Africa marked 20 percent and were substantially higher than in Anglophone Africa (MINEDAF, 2002, p.37). These exceedingly high rates pose a heavy financial burden on education systems struggling to achieve higher enrolment rates and better quality in primary education.

Repeaters use up resources (such as textbooks) twice for each grade they repeat and may overcrowd schools leading to insufficient space for new entries, which leads to additional costs for schools (see Bourdon, 2006, p.130). Moreover, parents who do not see their children progressing in school may consider the return to an additional year of schooling to be small and prefer to take them out of school and let them help in generating the household income (see PASEC, 2004, p.19 in combination with Bedi and Marshall, 2002, p.134).

A justification for grade retention in spite of these costs may be that students increase their achievement in response to their retention. However, very little is known about the impact of grade retention on student achievement in the context of a school system with very high repetition rates. To analyze this relationship, I use a unique panel data set from Senegalese primary schools with comparable test scores across grades. I estimate the impact of repetition on subsequent student achievement using a multi-level propensity score matching model that incorporates the development path of students with respect to their achievement and many other relevant student, teacher and school characteristics.

I find that, in general, repetition has a negative or insignificant effect on a student's subsequent achievement. The results suggest that high repetition rates are difficult to justify

considering not only the costs for the education system as a whole but also the effect repetition has on the individual student.

To further understand the potential benefits of education, I consider the importance of human capital for labor market decisions in chapter 3. In a setting where wage employment opportunities are scarce, the ability to become self-employed, for example by setting up a small business, can be very valuable. However, it seems that mainly two things could go wrong: First, individuals may not have enough knowledge and skills to become self-employed and may therefore face educational constraints. Second, they may not have the financial means to start a self-employment endeavor. In this context it is useful to analyze households who receive distinct amounts of remittances as the latter can alleviate liquidity constraints. Since both educational and financial constraints need to be considered simultaneously, I develop a theoretical model that incorporates both constraints and shows that individuals will only opt for self-employment if they have a minimum level of knowledge as well as sufficient financial means. I test the predictions of this model in an empirical analysis and find evidence that indeed remittances increase self-employment only for higher levels of schooling.

Remittances, as a means of alleviating liquidity constraints, may not only be useful for occupational choice considerations for working age individuals depending on their human capital but they can also be directly used to increase schooling of children. However, for a household to receive remittances, usually an adult household member migrates which can have counteracting effects on the schooling decisions of the household's children. In chapter 4, I disentangle the potential theoretical effects of remittances and migration on educational attainment of children. The empirical analysis finds no evidence of a positive effect of remittances on educational outcomes of children and therefore casts doubt on the importance

of financial constraints for the schooling decisions. In contrast, the schooling level of adult household members appears to be highly relevant in explaining child education.

Chapters 2-4 are self-contained such that they introduce, discuss and conclude the relevant research questions and the theoretical and empirical results within the respective chapter. Finally, in chapter 5, I offer concluding remarks that highlight the contributions of this dissertation and show the scope for future research in the field of human capital, labor markets and remittances that results from this work.

2 Grade Retention and Student Achievement in Senegalese Primary Schools

2.1 Introduction

In developing countries high repetition rates are widespread. Repetition in this context refers to students re-attending the same grade, and is often perceived as a measure to maintain or achieve educational quality. Several reasons can be found why students are not promoted to the next grade. One may be that some students are not as emotionally mature as their peers and are retained in order to have additional time to develop individually (see Shepard and Smith, 1989). Also, students may be required to obtain a certain level of knowledge to be promoted (see Jacob and Lefgren, 2004, p.227). If this level is not achieved, the student has to repeat her grade. Furthermore, the practice of grade retention[2] may also act as an incentive or deterrent for students in order to encourage them to perform well and to put more effort into their studies (see Gary-Bobo and Robin, 2014, p.9).

In the broader context there are two initiatives formulating educational goals to which the issue of grade retention may be linked: The Education for All (EFA; see UNESCO, 2000) movement and Goal 2 of the Millennium Development Goals (MDGs; see United Nations, 2014) that seeks to achieve universal primary education of high quality. If repetition rates are very high, the educational system may quickly suffer from overcrowding (see Bourdon, 2006, p.130) if additional educational inputs and infrastructure are not provided. When enrolment rates stay constant there will be more students per class the higher the number of repeaters.

[2] The terms “grade retention” and “grade repetition” are used synonymously throughout this chapter.

With growing class sizes, pupil–teacher ratios increase and the schools may not be able to manage high levels of school enrolment (see Bernard, Simon and Vianou, 2005). An education system that is overloaded as a result of high repetition rates therefore endangers the aims of the two initiatives.

While there is a heated debate about the efficiency of grade retention in developed countries (see, for example, Gary-Bobo and Robin, 2014), little research has been done with respect to developing countries so far. It is necessary to analyze developing countries separately as the educational framework there differs considerably. Repetition rates are much higher in developing countries. Around 2000, average repetition rates in primary education marked roughly 20 percent in Francophone Africa and more than 10 percent in Anglophone Africa (MINEDAF, 2002, p.37). In Senegal, repetition averaged roughly 10 percent per grade in 2000 and decreased to about 5 percent in 2010 (UNESCO, 2011). Often these countries face problems that are virtually unknown in the developed world (e.g. low school attendance during harvesting season or a large distance to the nearest school). Other problems, like the costs of retention, are similar but their impact is different (developing countries face different financial constraints). When repetition rates are extremely high it is difficult to simply argue that all the repeating students are not mature enough or did not acquire the necessary knowledge to proceed to the next grade. Instead, the question arises as to how effective these high repetition rates are and how much they actually benefit the individual student. Given the high costs of overcrowded education systems for developing countries, repetition may only be justified if it has a clear positive effect on subsequent achievement of students.

Recent empirical evidence on the effects of grade retention in developed countries is ambiguous.[3] Jacob and Lefgren (2004) use a regression discontinuity design (RDD) to study the test-based promotion policy in Chicago schools and show that repetition has a positive impact on the test scores of grade 3 students that is decreasing over time, but no impact on the achievement of sixth graders. Similarly, the pattern of short-term positive effects and the lack of an impact in the medium term are reported by Alet (2010) for French students. The author uses an instrumental variables (IV) approach and reports that grade retention in grades 1 and 2 improves student achievement in the short run (grade 3) but loses its impact on test scores after several years, when students are in grade 6. Another study in France by Mahjoub (2008), using an IV approach as well as a matching approach, finds a positive impact of grade repetition on student achievement and on the probability of graduation. Fertig (2004) also finds a positive effect of grade retention on educational outcomes (increased probability of obtaining a high schooling degree) in Germany, when tackling unobserved heterogeneity by instrumenting for grade retention.

Research on grade retention in developing countries is generally quite scarce and no less ambiguous than the literature in the developed world. The main problem is that adequate data from developing countries are hardly available and their quality is often inferior. Manacorda (2012) uses regression discontinuity to analyze Uruguayan public schools. He shows that automatic grade failure (when students miss more than 25 days of school) has a negative impact on educational outcomes four to five years after failure. In contrast, Gomes-Neto and Hanushek's (1994) analysis of primary schools in Brazil's rural northeast finds that repetition has a positive impact on achievement scores in later grades.

[3] For a broader review of recent work on grade retention, see Gary-Bobo and Robin (2014).

In-depth studies on the impact of grade retention in Sub-Saharan Africa are very scarce and the existing literature has not been able to clearly infer causality for at least two reasons. First, the analyses rely on simple ordinary least squares (OLS) or multi-level techniques that are likely to suffer from omitted variable bias as unobserved student ability is not accounted for. Second, the studies generally confine their analyses to common items of the tests of subsequent grades, thereby discarding a substantial amount of information. Bernard et al. (2005) analyze the five-year PASEC[4] panels for Côte d'Ivoire and Senegal and find a strong negative relationship between previous grade retention and test scores in grades 4 and 5. In PASEC (2004), the panel for Senegal is used to examine the impact of repetition on subsequent achievement separately for different grades. In this analysis, the test scores of repeaters are compared to those of promoted students but only for those test items that were common in both tests. The results suggest that throughout different grades repeaters perform worse on these tests than promoted students, even if initial achievement and other variables are controlled for. Labé (2011) also uses the common items of the tests in these panel data and finds a negative effect of retention on subsequent achievement. While PASEC (2004) relies on simple OLS methods, Labé (2011) applies a multi-level model to cope with the structure of the data. Both are likely to suffer from omitted variable bias as unobserved student ability has not been accounted for. The analyses in this chapter build on the work of these studies but use a much larger set of information as detailed below. Furthermore, recent PASEC reports on other Francophone Sub-Saharan African countries also use simple regression techniques for their cross-sectional data and find negative effects of retention on achievement (see e.g. PASEC, 2009; 2010a; 2010b).

[4] Programme d'Analyse des Systèmes Éducatifs de la CONFEMEN (PASEC), where CONFEMEN stands for Conférence des Ministres de l'Éducation des pays ayant le français en partage.

This chapter contributes threefold to the literature. First, this analysis tackles the issues regarding the content as it considers the development of students in terms of achievement several years after their retention (not just the first subsequent year) and does not confine itself to specific items in student test scores. Second, it targets the problem of causal inference by including the development paths of students before retention, which are likely to account for relevant (unobserved) covariates that have not been surveyed. By employing this methodology I strengthen the credibility of the statistical assumptions, in particular the conditional independence assumption (CIA). Student fixed effects models that also target the issues related to possible endogeneity due to innate ability of students or other unobservables are employed as robustness checks. Finally, I am not aware of any other study on this topic in the context of Francophone Sub-Saharan Africa that uses a panel data set where test scores of the same students in different years are available and comparable.

The results of the matching and panel matching estimations suggest that there is a negative or in some cases an insignificant effect of repetition on subsequent student achievement. These results are corroborated in robustness checks using fixed effects and random effects models. Moreover, there is no evidence that the effects differ for students with higher or lower test scores prior to repetition.

The remainder of this chapter is structured as follows. Section 2.2 elaborates on possible links between retention and subsequent student achievement. Section 2.3 gives details on the data used and data management. Section 2.4 explains the methodology used and section 2.5 reports the results of the analysis. Finally, section 2.6 concludes.

2.2 The link between retention and achievement

Repetition is likely to have an effect on student performance via a number of channels. One greatly debated feature of retention in the literature on developed countries is the fact that retained students may suffer emotionally (see, for example, Smith and Shepard, 1989, p.216) which may be perceived as detrimental to the motivation of the student. The student will see her peers promoted to the next grade and therefore may perceive her academic failure as a personal one. The more often the student repeats, the more strongly the personal failure may be perceived. Moreover, it may well be that the student is mocked by her old and new peers who have been constantly promoted so far, and thus she could feel ashamed (see Byrnes, 1989, p.124). In addition, the student will have to settle in her new class, starting anew with making friends and striving to get socially accepted by her peers. As the student will be older than her new classmates, she will have to struggle harder to achieve acceptance from her peers and therefore suffer from motivational drawbacks (cf. Roderick 1994, 1995). However, these linkages are more likely to hold for developed countries than for the developing world, where repetition rates per grade are so high that the individual repeater is less likely to be isolated or ashamed. Another reason for demotivation that is more specific to developing countries may lie in the awareness of the student of the additional costs she is causing by her grade repetition. If we perceive schooling as a cost–benefit consideration (as in Bedi and Marshall, 2002 or Glick and Sahn, 2010), even if there are no fees, the (opportunity) cost of schooling may be high since the student could work in the family business or labor market instead of attending school. The benefits for the student are human capital accumulation and thereby increased job market opportunities later in life (see also PASEC, 2004, p.19). If a student is aware of the cost an additional year of schooling is causing for her family she may

well be demotivated, resulting in lower achievement or even dropout. As students are able to work more and gain higher wages the older and stronger they become, these opportunity costs tend to rise with increasing age. This argument is already relevant for early primary grades, specifically in the case of late school enrolment or multiple repetitions.

When students repeat, there will be additional learning in this year (see Gomes-Neto and Hanushek, 1994) – possibly to fill knowledge gaps or to acquire further knowledge – and they should perform better, relative to their new peers, than they did, relative to their old peers, in the previous year (see also Bernard et al., 2005, p.55). The differentiation between old and new peers is important when comparing the students. On the one hand, we may analyze how the student develops compared to her new classmates (she will, however, have had one more year of schooling) or compared to her old classmates who have been promoted to the next grade (but have as many years of schooling as the repeating student, see Holmes, 1989, p.21). These two concepts will be detailed in subsection 2.5.1. Using the rationale that retention will give the student an additional year of schooling, I posit the baseline hypothesis that, relative to their new peers, repeaters will do better than they did relative to their old peers in the previous year.

It is not easy to judge whether filling knowledge gaps on the positive side or demotivational aspects on the negative side have a stronger impact on subsequent achievement after retention. The latter, however, is likely to have a greater influence for two reasons. Theoretically, retention is rather difficult to explain by knowledge gaps for high and medium achieving students, of which there are apparently a considerable number (PASEC, 2004, p.12; Bernard et al. 2005, p.42). Their demotivation may be expected to be even stronger as they may regard the repetition decision to be unjust. Moreover, empirically, the results of recent PASEC reports from other Francophone Sub-Saharan African countries

suggest that retention impacts rather negatively on subsequent achievement (e.g. PASEC, 2009; 2010a; 2010b).

If the consideration that demotivation is the stronger argument is true, we could expect that a retained student will in fact perform worse in subsequent grades than if she had been promoted. Furthermore, when the student enters higher grades of primary school she will approach early adolescence and the difference between older and younger students may become more obvious. These may arise in physical or emotional form and emphasize the differences between older students (who have repeated in the past) and students of average age (see Roderick, 1994, p.742). As I am analyzing primary grades the problem of being over-age may be the more pronounced the higher the grade. As the ability to work and the strength of the student increase the older the student gets, the opportunity costs increase as well. This may also lead to demotivation if the student feels she could work in the family business or the labor market instead of attending school. In this case, grade repetition in early primary grades could have more negative effects after more years following the repetition than in the direct aftermath. On the other hand, a one year age difference is relatively greater for younger students than for older ones which may result in more negative effects in the first year after retention. Therefore, it is ultimately an empirical question if, for early primary grades, repeaters will perform worse the longer retention dates back compared to a matched control group of promoted students or if the impact of retention on achievement in the subsequent year is nullified or reversed after more years.

2.3 Data and data management

2.3.1 Variable selection

The analysis of this chapter uses exceptionally rich panel data from Senegalese primary schools surveyed during the period 1995–2000 (see PASEC, 2004)[5]. The survey was conducted as part of PASEC in a cooperation between the Senegalese Ministry of Education and CONFEMEN[6] starting with a stratified random sample of roughly 2,000 students at the beginning of their second grade in 1995 and following this cohort for five consecutive years or until the respective students dropped out of school. The students were tested each year in both Math and French.. This survey was specifically designed to allow for a thorough analysis of repetition practices and their consequences in Senegalese primary schools. The data include a wide range of variables detailing the characteristics of the students and of their environment. These data come from questionnaires for students, teachers and directors giving insight into the socio-economic background of students, the schooling conditions and the characteristics of their teachers (see Bernard and Michaelowa, 2006 and PASEC, 2004). Twenty students were selected at random in each of just under 100 schools to answer the questionnaire and participate in the tests leading to 1,977 observations, of which 1,746 have a non-missing test score value. Since the number of dropouts is considerable the number of observations decreases from one survey wave to the next. In addition, some students were not at school on test days and account for some of the missing data in the test score variable. For these reasons, there are only 1,009 observations with a non-missing test score value left in the last

[5] The raw data of the PASEC panel for Senegal is available from CONFEMEN (www.confemen.org) upon request.
[6] CONFEMEN stands for Conférence des Ministres de l'Education Ayant le Français en Partage.

year of the survey. For the matching analysis, the data are split by grade in order to enable an analysis for each grade level (see a detailed explanation in section 2.4).

The explanatory variables are classified into three major categories, as shown in Table 2.1:[7] Student-specific characteristics that include mainly the respective socio-economic status (see, for example, Dumas and Lambert, 2011, on the relationship between socio-economic background and schooling in Senegal), class variables, and teacher characteristics. Six variables are used to identify the socio-economic status, namely the student's gender (*boy*)[8] and age (*student age*), the work obligations outside school, the intake of meals, an index for property at home and an index for media availability at home.[9] The latter three variables are additive indexes each of which consists of the sum of their components. Work obligations outside school (*work at home*) is a categorical variable comprising eight possible work fields: Cooking, cleaning, washing, agriculture, animal husbandry, dishwashing, childcare and commercial activities. This index shall account for the distraction from school activities and the reduced time available for homework and home study. The index for property at home (*property at home*) details the wealth situation of the student's family, comprising the possession of a car, a fridge, a flush toilet, electricity and/or a water tap. The index of media availability (*media availability*) contains information on the possession of a TV, radio and/or video device at home. The latter variable can be perceived as an additional wealth index. By the nature of its components, it can also be linked to education since consuming videos, radio and TV shows may improve a child's understanding in the spoken languages, drive curiosity or even be directly useful as educational transmitters when transferring useful knowledge (see Michaelowa, 2001, p.1705). For this reason, it is separated from the previous property index.

[7] Appendix D comprehensively details editing and imputations from the raw data to the final data set.
[8] The variable names are indicated in parenthesis as used in the tables.
[9] For variable descriptions, see Table A1 in Appendix A.

Finally, intake of meals (*meals*) measures if the student has regular breakfast, lunch and dinner. I consider this important as the link between nutrition and educational outcomes has been established in the literature (see Michaelowa, 2001; Vermeersch and Kremer, 2004; Glewwe, 2005). Besides these student characteristics information is included on the individual schooling conditions and knowledge of the respective child. In particular, the analysis includes the number of grades repeated up to the current grade (*prior repetition*). I regard this to be important information since I want to measure the effect of a specific repetition decision (*repetition*) that could in turn be influenced by prior repetition. What is more, with respect to personal schooling conditions I include current Math test scores (*test scores*), which should be important in determining repetition. Moreover, I include two variables indicating if the student speaks French at home (*student speaks French at home*) and the number of languages spoken (*languages student*). Finally, I include a variable that measures if the student studies at home and gets help there with her studies (*study at home*).

A number of variables are used containing information on class or school characteristics[10]. One is the size of the class (*class size*) (see, for example, Angrist and Lavy, 1999; Case and Deaton, 1999; Hanushek, 1998, on the impact of pupil–teacher ratios/class size on student achievement) and another two are the shares of available Math books (*share math books*; see, for example, Frölich and Michaelowa, 2011 or Fehrler, Michaelowa, and Wechtler, 2009, for studies in the context of Sub-Saharan Africa) in the class of the student and a variable indicating if the class is organized in a double-shift manner (*double shift*), where different classes use the same room at different times of the day. Furthermore, the estimations include a measure of urbanization of the school location, differentiating between small village, big village, suburban area and town (*city size*).

[10] As only one class per school has been sampled I use the terms class and school characteristics as convenient.

In addition, variables on class characteristics are included that reflect class and school management. This includes the number of students in the first six grades and therefore a measure of school size that may influence the organization of the school (*number of students*). Smaller schools may exhibit a more familial relationship between students, teachers and the director. This may have an impact on individual repetition decisions and on test scores. Another variable (*teacher meetings*) measures how often the director meets with all the teachers in school. This variable may reflect how much discussions and exchange of opinions are valued among the teachers and with the director. In addition, a variable that indicates the number of partnerships (*partnerships*) a school has with foreign schools, non-governmental organizations or other aid organizations or bilateral co-operations. These partnerships may influence the general perceptions of a school with regard to grade retention or other policies.

Additional variables are the share of repeaters per class (*share repeaters in class*) and the mean score of a class (*mean score of class*). The reasons for the inclusion of the latter two variables and their importance are detailed in subsection 2.5.1.

Finally, teacher characteristics are considered by variables for the gender of the teacher (*male teacher*), the training he or she received (*teacher training*) and the work experience he or she obtained (*teacher job experience*). The teacher training variable is a categorical one starting with a value of zero for no training up to a value of five for a training period of more than twelve months. Job experience contains teaching experience in number of years. Furthermore, I include variables indicating if the teacher speaks French at home (*teacher speaks French at home*) and if he or she speaks the local language (*teacher speaks local language*).

Table 2.1: Summary statistics

Variable[1)]	N[2)]	Mean	Std. Dev.	Min	Max
Student characteristics					
repetition	5588	0.16	0.37	0	1
prior repetition	7468	0.49	0.66	0	4
test scores	6488	0.28	1.95	-6.2	6
test scores grade 2	1742	-1.33	1.52	-6.21	3.98
test scores grade 3	1641	-0.18	1.42	-5.21	4.57
test scores grade 4	1330	0.98	1.36	-3.15	5.69
test scores grade 5	1140	1.82	1.26	-4.4	5.77
dropout after grade 2	2070	0.14	0.34	0	1
dropout after grade 3	1844	0.12	0.32	0	1
dropout after grade 4	1475	0.07	0.25	0	1
boy	7349	0.55	0.5	0	1
property at home	7349	3.25	2.35	0	7
media availability	7349	1.57	0.92	0	3
work at home	7434	3.14	2.07	0	8
meals	6414	2.56	0.57	0	3
student age	7452	10.07	1.7	6	17
student speaks French at home	7349	0.1	0.30	0	1
languages-student	7349	1.17	0.61	0	7
study at home	7238	1.72	0.59	0	2
Teacher characteristics					
teacher training	5244	3.47	1.36	0	5
male teacher	5283	0.65	0.48	0	1
teacher job experience	4413	13.94	8.46	1	37
teacher speaks local language	4008	0.72	0.45	0	1
teacher speaks French at home	3996	2.56	0.84	1	4
Class characteristics (including class management)					
mean score of class	7249	0.38	1.54	-5.2	6
share repeaters in class	7272	0.14	0.11	0	1
double shift	4828	0.28	0.45	0	1
class size	4172	51.53	15.05	12	148
share math books	6254	0.41	0.35	0	1
city size	6726	3.06	1.17	1	4
number of students	7145	702.45	363.53	14	1965
partnerships	7384	0.48	0.65	0	3
teacher meetings	7384	2.58	0.95	0	4

[1)] Descriptive statistics of complete data set after partial imputation without dropouts (except in the case of the variable dropout).
[2)] The number of observations differs across variables as some of them refer to a single grade (for example test scores grade 2), to all years of the data for each student (for example repetition) and due to missing values.

2.3.2 Item response theory (IRT)

An excellent feature of the data used here is the availability of observations across time for the same students, specifically their achievement measured by test scores. Educational data with this property are almost non-existent in developing countries. In most studies where panel data are available – even for developed countries – comparability is severely restricted as the difficulty of the tests varies with the different grades in which the students are tested. For this reason, most studies referred to above confine their analyses to common items (of two consecutive years), i.e. questions that are identical in the tests of the grades that the researcher intends to compare. When using this methodology the problem arises that only a small part of the actual test is analyzed, therefore leaving out potentially important information from other test questions. Furthermore, the more distant the analyzed grades are, the more difficult it will be to find a sufficient number of common items. If they exist at all, they may not reflect very well what the students learn, as it is unlikely that there will be much additional progress on simple items of grade 2 when the student attends the last grade of primary school. I believe this additional aspect to be of significant importance as it could bias the analysis of prior studies that rely only on items that are common throughout the grades compared. The IRT calculation overcomes this problem due to the use of anchor items, i.e. common items across tests, that also change over the years, thereby linking only one or two years.

For this reason, the opportunities of IRT were used where questions that are not identical in different tests are made comparable (see Hambleton, Swaminathan, and Rogers,

1991).[11] This methodology aims at assessing item difficulties instead of test difficulties. Using anchor items, the remaining items that vary in the tests of the different grades are calibrated in order to achieve a common scale for the different tests. The assumption is that item difficulty and student's ability are invariant. The test difficulty estimates do not change depending on the particular set of students (and therefore the particular set of abilities) and vice versa. As item difficulty and ability are unknown a priori, they are jointly estimated by weighted (maximum) likelihood estimation (WLE; see also Warm, 1989). Data calibration was complex due to the length of the panel. In particular, in the case of French this meant that the concepts covered by the different items could not be considered to reflect one and the same dimension of learning. WLE scores for Math, however, could be calculated, thus allowing for a comparison of test scores across all tests and therefore across all the years of the panel.

2.4 Methodology

2.4.1 Empirical approach

This analysis benefits from three major advantages over the existing studies of grade retention in Sub-Saharan Africa. First, as discussed above, I do not confine the comparison between repeaters and non-repeaters to the common items of tests of consecutive years but use the more complete information extracted by the application of IRT methodology. Second, I also analyze the effect of grade retention on student achievement more than one year after the repetition decision. This is important to infer not just the immediate effect of repetition but the effect on achievement after several years. Third, by using a multi-level matching methodology that includes the development path of the student with respect to relevant

[11] I would like to thank Christian Monseur for the calculation of these comparable test scores.

covariates I overcome statistical shortcomings of earlier work in this field (for example PASEC, 2004; Labé, 2011) that could not establish the causal effect between repetition and student achievement.

While PASEC (2004) largely relied on OLS methods and Labé (2011) implemented a multi-level model, this analysis makes use of propensity score matching to infer the impact of grade retention on student achievement. This method is chosen for a number of reasons. One advantage over the other methods is the lack of assumptions regarding the functional form, i.e. I do not assume linearity. More importantly, comparisons should only use existing observations. While OLS extrapolates into regions where there are possibly no observations, the matching algorithm ensures that results are based on actual observations.

The aim of this study is to infer how students would have performed if they had not repeated. For this counterfactual analysis, it is necessary to find students with similar characteristics in order to compare them. The students are matched based on observable characteristics such as their background inter alia as discussed above. The method is based on the conditional independence assumption (see Dawid, 1979):

$$Y_{di} \perp\!\!\!\perp D_i \mid X \qquad (2.1)$$

where D takes the value 1 if student i belongs to the treatment group (here: repeaters) and 0 if the student belongs to the control group and Y is the potential outcome (here: student achievement). If this assumption is satisfied there is no selection problem once observable characteristics are controlled for. In other words, adjusting for student, school and teacher characteristics, the potential outcome Y does not depend on participation status D. Accordingly, all relevant variables would need to be included separately. As Rosenbaum and

Rubin (1983) have shown we may use the probability of treatment instead, where matching is based on a single number, i.e. the propensity score:

$$Y_{di} \perp\!\!\!\perp D_i \mid P(D = 1 \mid X) \qquad (2.2)$$

Consequently, the probability of being treated may be compared instead of comparing all relevant characteristics X. The probability of treatment for each student is generally calculated by a logit or probit estimation. The panel data used in this chapter have a multi-level structure of two levels. Students are nested within classes. As students within the same class tend to be more alike we cannot guarantee independence between observations within classes. Therefore, I opted for a multi-level logit function to estimate the treatment probabilities of each student. This estimation specifically takes into account the different levels and the correlation of student characteristics within a class. The model is essentially a random effects model and may be written as follows (see Gelman and Hill, 2007):

$$D_{ij} = \beta_{0j} + \beta_1 X_{ij} + \varepsilon_{ij} \qquad \text{(2.3) Micro model (student level)}$$

$$\beta_{0j} = \gamma_0 + \gamma_1 W_j + u_j \qquad \text{(2.4) Macro model (class/school level)}$$

$$D_{ij} = \gamma_0 + \gamma_1 W_j + \beta_1 X_{ij} + \varepsilon_{ij} + u_j \qquad \text{(2.5) Reduced form}$$

where D is the treatment variable (grade retention) that takes values one or zero, X indicates variables on the level of the student (i) and W on the level of the class/school (j). ε and u are individual and class/school level residuals respectively.

Furthermore, the time dimension of the panel data needs to be taken into account. However, the assumption of independence between matched observations and the stable unit

treatment value assumption (SUTVA) should not be violated. SUTVA states that the potential outcomes for one observation are independent of assignment to treatment of other observations. Therefore, I do not match a student in grade 2 to herself in grade 3 or to herself in any other grade. Nielsen and Sheffield (2009) argue that matching should be based on panels, paying attention to ensuring that control samples do not overlap. In their example they match "Mali 1989–1998" with "Malawi 1991–2000" and "Mali 1979–1988" with "Niger 1981–1990" (Nielsen and Sheffield, 2009, p.18). Therefore, they overcome the problem of possible dependence among country–year dyads.

In the case of repetition, however, it is not advisable to adopt this procedure in exactly the same manner as I am specifically interested in the impact of repetition in a certain grade, i.e. I distinguish between students repeating grade 2, grade 3 and so on. Consequently, the analysis will draw from the matching methodology used by Findley and Young (2011), who split panel data by year, match observations within these subsamples and reconstruct these partial data sets into a new panel data set. This procedure guarantees that the same student is not matched based on different years. For the purposes of this chapter it is not necessary to reconstruct the partial data sets. I will report on the results for each available primary school grade separately. For a specific example, consider the grade 3 students. A student who repeats in this grade will be matched based on her characteristics in this grade to a student who is promoted to grade 4, based on that student's characteristics in grade 3. Then, the difference in test scores between these two students one, two, etc. years after the repetition of one of the students will be compared. In this way, the effect of repetition can be assessed over time. This cross-sectional analysis will be specification 1 in the empirical analysis below. Since specification 1 does not make use of time trends before retention, the method is further

adjusted by including the development of the students' achievement (and other covariates) before the decision about repetition.

When there is more than one time-observation before the repetition of a student, it is useful to match panels with two or more years. For this purpose, I adapt the methodology of Nielsen and Sheffield (2009) by restricting the matching algorithm to matches based on corresponding years, for example matching student i based on i's observable characteristics in grades 2 and 3 to student j based on j's characteristics in grades 2 and 3 in order to receive results for retention in grade 3.

There are two issues to consider here. First, how many time periods before the grade of treatment should be included in the matching? Second, based on how many explanatory variables with information referring to pre-treatment years can be matched? The first question is easy to answer with respect to the data used. As there is only a short panel of five years, all pre-treatment years are included for this part of the analysis. That is, students repeating grade 5, for example, are matched based on four previous years (i.e. grades 2 to 5). Students repeating grade 3 for another example are matched based on two previous years (grades 2 and 3). The second question is more difficult to answer. For the same example of a grade 5 repeater, the estimations would need to include the explanatory variables for four pre-treatment years, resulting in a large number of explanatory variables. We may therefore expect difficulties in achieving balance among all covariates, which is crucial for the matching procedure to work. These problems can, however, be tackled using the appropriate matching algorithm that are detailed below. Furthermore, not all variables that have immediate effects need to be directly relevant for later years (e.g. how much the class size of a student four years earlier would influence current retention of a student). If a variable has an impact, it is likely to be indirectly channeled through student achievement in these pre-

treatment periods. Therefore, I choose to take into account the time dimension for the variable I judge most important for the retention decision and that should also reflect these other variables in an indirect way, namely the test score. This is specification 2 in the analysis below. The test score is indeed the most significant variable in explaining retention, which is evident from the propensity score estimation (as discussed in subsection 2.5.2 and shown in Appendix B). Nevertheless, I also report on the results with time trends for all explanatory variables (specification 3). As I expect that the change in test scores from one grade to the next is more relevant than the level of test scores in each year, only the first year test score is included besides the changes from that grade to the next, the change from that new grade test score to the next, etc. The same procedure to compute time trends was used for all other covariates in the alternative specification 3, which includes time trends for all variables.[12]

One of the most important tasks in this kind of matching estimation is to make sure that there is balance between the treatment and control groups with respect to all of the covariates used in the estimation. That is, observations need to be found that are indeed comparable and that do not differ significantly in their characteristics. For the data of this chapter, radius matching, which makes use of a caliper, leads to very good matches in most of the specifications (see Appendix C). Caliper matching defines the maximum difference in propensity score between two observations that may be used for comparison. In contrast to nearest neighbor matching, caliper matching avoids bad matches when the best comparison observation is very different. I have defined this distance to be no more than 0.05.[13] One possible drawback compared to nearest neighbor matching – specifically in the case of few observations – is that using caliper matching may lead to fewer matches and may therefore

[12] See Figure A6 in Appendix A for an illustration of the allocation of matches.

[13] The propensity score is the probability of being treated and therefore lies between 0 and 1. The value 0.05 signifies that the propensity score of matches may be a maximum of five percentage points above or below the propensity score of the treated observation.

result in a higher variance of the estimation. I therefore follow the suggestion of Dehejia and Wahba (2002), who propose radius matching, that is to use all comparison observations within the caliper not just the nearest one, in order to overcome this problem (see also Caliendo and Kopeinig, 2008).

2.4.2 Potential limitations of methodological approach

The (panel) matching approach detailed above is a selection on observables methodology that relies upon the assumption that all relevant characteristics of students are included.[14] Subsection 2.3.1 on variable selection showed that a large number of student, teacher and school characteristics were included that may be relevant for grade retention and future test scores of students. However, there may still be unobserved variables that may affect grade repetition conditional on included observable covariates, which may potentially confound the results of the estimations. In general, there may be two types of unobserved variables: Those that can be perceived as constant over time, such as student ability or – to some extent – motivation and those that should be regarded as sudden and/or unexpected, such as economic shocks to the household of the student.

Student ability is a typical unobserved factor in educational studies, which cannot be inferred from survey data. However, ability is likely to mainly affect grade retention through prior student test scores or the change in test scores over time, both of which the study controls for. Including prior test scores would be equivalent to a standard value-added approach. This study goes beyond that with the additional inclusion of the change in test scores over time. Similarly, if motivation is regarded as a constant characteristic of a student,

[14] I would like to thank two anonymous referees for pointing me towards identification problems with respect to selection issues and student motivation.

then it is likely to have an effect on current grade retention through past retention, which is a control variable in this study. However, to the extent that motivation is not a constant characteristic of a student but of sudden nature its exclusion may be problematic for the estimation and may bias the matching estimates. In this case it is decisive where the lack of motivation stems from. If it is caused by observed teacher characteristics or by low learning progress during the school year this would also not be a problem for the estimations of this study as teacher characteristics and test scores are controlled for. If it is caused by other unobserved issues such as personal problems because of family issues or the like it might influence the estimations. Motivation can be expected to be positively correlated to future test scores. If grade repetition and motivation are negatively correlated then omitting a measure for motivation will underestimate the effect of grade retention on subsequent test scores. This gives some confidence in the estimates reported below. The size of the bias may then depend on the frequency that such lack of motivation based on unobserved factors appears in the sample, the strength of this motivational effect and its change over time. We may conjecture that the bias will be reasonably small because much of the correlation between grade retention and motivation may be expected to be captured by current test scores, the mean score of the class and to a lesser extent the large number of covariates included. Moreover, the specifications including the development path may decrease concern of bias to the extent that unobserved variables such as motivation should be captured by the development of test scores and other covariates of a student from one grade to the next if they do indeed have an impact on future test scores.

Analogously, sudden shocks to the household of students may have an influence on grade retention conditional on test scores. This may be the case if parents fall ill or if there are unexpected economic shocks (e.g. due to a lack of agricultural output). Students may then

have to help at home or contribute to the household income. These shocks are likely to increase their risk of grade repetition and may also be negatively correlated with future test scores. This would also mean that the coefficients of the matching estimations would be underestimated. Moreover, these shocks may partly impact on grade retention and test scores through variables that are included in the estimations, such as students' work obligations and their possessions at home that are time varying and that proxy the economic conditions at home.

To the extent that time-invariant variables are not sufficiently captured in the specifications including time trends in covariates, subsection 2.5.4.1 estimates fixed-effects models as robustness checks that alleviate concerns in this regard. Nonetheless, they also cannot prevent bias to occur due to time-varying factors.

A second potential limitation is selectivity since a noteworthy share of students drops out (see summary statistics in Table 2.1). The main analysis discards these dropouts since we do not have measures of their future achievements as they did not take tests after their dropout. The selectivity of remaining students may produce bias as grade retention and student dropout are likely to be positively associated (see, for example, André, 2012; Mancorda, 2012; Glick and Sahn, 2010). If grade retention indeed increases the likelihood of dropout, then a negative effect found in the existing sample will be a conservative estimate and the actual effect will be more strongly negative. Subsection 2.5.4.3 provides a detailed discussion on the selection problem and presents results from simulations that give insights about the strength of the main results of this study.

2.5 Results

2.5.1 Tracking issues and descriptive graphical findings

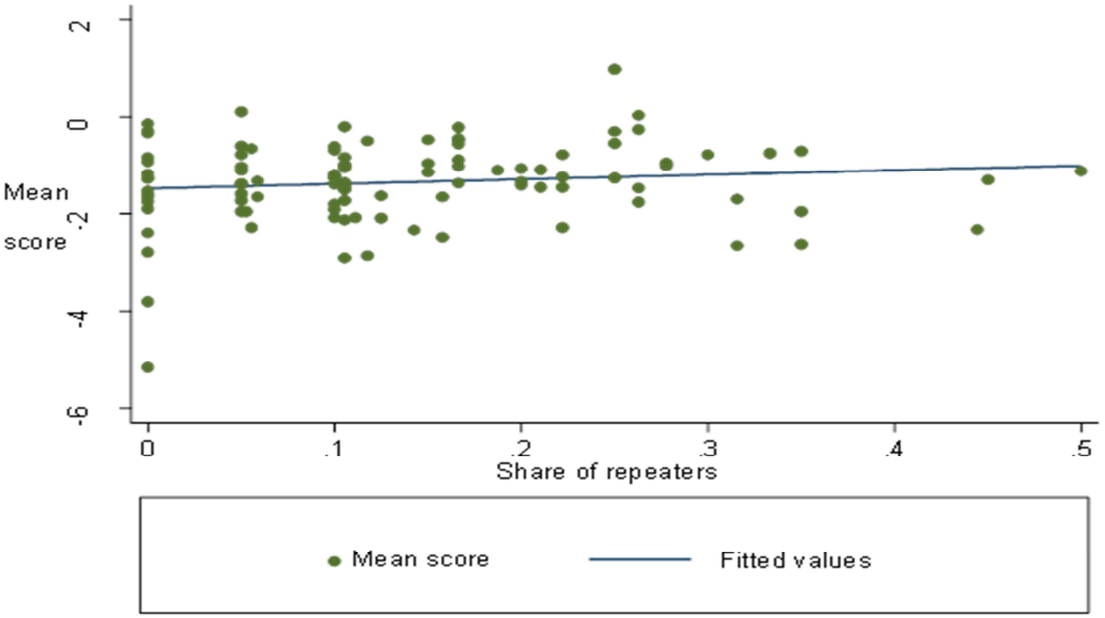
Before starting with the analysis of the relationship between retention and student achievement let us briefly discuss the issue of tracking (see, for example, Rothstein, 2010) that has been detailed in recent education literature and that may possibly bias the results if it is not accounted for. The idea is that teacher value added models may produce biased estimates when students are not randomly assigned to teachers but are assigned based on observed or unobserved characteristics. As an example, a class of students who obtain higher test scores on average may be assigned to a different teacher than a class with low average scores. As the skills of these teachers may differ they may affect the future outcomes of students, which are the object of this analysis. Even more so, regarding this analysis, repeaters may be sorted into different classes (for example, lower-achieving ones to reduce the within-class variation). The latter could be the reason for differences in future outcomes between promoted students and repeating ones in lieu of the treatment variable grade retention. The data used do not allow for experimental analysis of this issue such as was conducted by Kane and Staiger (2008) who show that the value added model they implement does not suffer from biased estimates. I can, however, show that selection of repeating and promoted students into classes of different average scores does not seem to occur in the data used.

Figure 2.1 shows the relationship between the share of repeaters and the mean score of students per class for second graders.[15] The fitted line has a slight and insignificant positive

[15] This figure and the corresponding ones (Figures A1, A2 and A3) in Appendix A are based on grade 2 as the data structure does not allow for similar analyses in other grades. As there is no reason to believe that this pattern changes over time, I conjecture that it remains the same across the panel.

slope. This suggests that repeating students are not assigned into low-achieving classes to separate them from high-achieving students. Several similar exercises can be found in Appendix A. Based on these results I do not believe that there is a particular rule for assigning repeaters to different classes than promoted students.[16] Furthermore, possible sources of bias are alleviated from assignment of classes to teachers based on mean scores and share of repeaters on the class level by including these variables as additional covariates in the estimation of the propensity score, as indicated in the variable description of subsection 2.3.1.

Figure 2.1: Relationship between share of repeaters and mean score per class



It is important to note that there are two differing concepts in comparing the treatment and control observations in the post-treatment period (see Holmes, 1989, p.21). They reflect the varying views on the purpose that is attributed to grade retention. The first one (concept (a)) analyzes how much a student should learn during one year of schooling. Therefore, if a

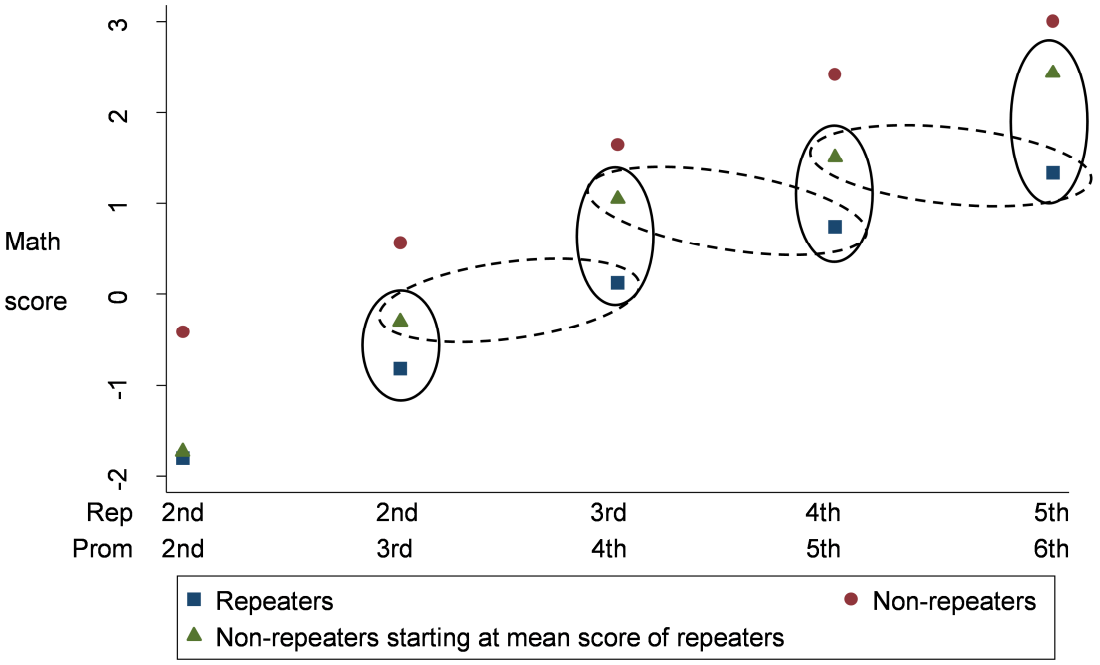
[16] Since the figures show that classes with a higher or lower percentage of repeaters do not differ systematically in their mean test scores, they also deliver suggestive evidence that there are no peer effects stemming from repetition.

student repeats grade 3, her achievement one year later (she is still in grade 3) is compared to a non-repeating student who is in grade 4 by then. The idea is to analyze the changes in student achievement from one year to the next given repetition and non-repetition.

The second concept (concept (b)) reflects the idea that a student should have a certain level of knowledge by a specific grade. Therefore, if a student repeats grade 3, her achievement two years later (i.e. in grade 4) is compared to a non-repeating student one year later who at that time is in grade 4. This kind of comparison aims at finding out if repeating enabled the student to reach the same level of knowledge in grade 4 as the non-repeating student. Note that in this case the repeating student had one more year of schooling to reach this level. The different possibilities of comparison are illustrated in Figure 2.2.

It shows a grade 2 retention decision and follows the students till the end of the panel. Only those students have been selected who have not dropped out during the panel. The squares indicate students who repeated grade 2 and therefore lag one grade behind the grade 2 non-repeating students, which are shown by triangles. Concept (a) translates to a vertical comparison (solid circles) where the students had the same amount of schooling since the retention decision. Concept (b) can be applied by horizontal comparison (dashed circles), where a repeater when in grade 3 is compared to a non-repeater when in grade 3 and so on. As the mean test scores of non-repeaters are generally considerably higher (circular dots), I have selected those non-repeaters who roughly start at the mean of the promoted students in the first wave of the panel, i.e. approximately have the same starting point in terms of test scores. Referring to the vertical comparison we can clearly see that the repeating students build up a substantial negative gap in the post-retention years towards their old peers. As a consequence, for the same amount of schooling the promoted students will achieve higher scores than the retained students even though they started at the same initial level.

Figure 2.2: Comparing retained and promoted students (I)



The circles encompass the observations to be compared. The solid circles represent concept (a): The students compared have the same amount of schooling since the point of the repetition decision. The dashed circles represent concept (b): A grade 2 repeater when in grade 3 is compared to a promoted student when in grade 3, etc. N=22 for repeaters and N=58 for non-repeaters starting at mean score of repeaters.

Following the rationale of concept (b), we may now look at the horizontal comparisons. The retained students when in grade 3 have slightly higher test scores than the promoted ones had when in grade 3. So far, if the policy is meant to guarantee a certain level of knowledge by a certain grade, retention could be seen as a successful means to achieve this aim. Even in this context, it is important to note that the retained student had one more year of schooling to obtain this level. Moreover, looking at grades 4 and 5 the score of the retained students falls below that of the promoted student despite the additional year of schooling.

Therefore, we have to be more cautious about supporting retention even in the case of a same-grade comparison in line with concept (b).[17]

Even though other variables are not controlled for so far, we can make an attempt to answer the first hypothesis based on Figure 2.2. The figure shows the pathway in terms of the test scores of students repeating grade 2. Let us assume that the mean score in grade 2 remained constant over time, i.e. the mean score of second graders in the first year of the panel (which is known from the data) is the same as the mean score of second graders in the following year. Using this assumption we can simply compare the mean score of repeaters when they attend grade 2 the second time to their mean score when they attended grade 2 in the first year of the panel. As the mean score of the repeaters has increased, we can state that the repeater will be better in relative terms when compared to her new grade 2 peers than when compared to her old grade 2 peers. This does not come as a surprise as the repeaters had an additional year of schooling and there was some improvement of scores during that year. The result of this simple and straightforward analysis corroborates the perception that teachers may believe retention to be useful as they can see the relative improvements of repeaters in their new class (see Bernard et al., 2005, p.64).

[17] For variations of this figure with different starting points for promoted and retained students, see Figures A4 and A5 in Appendix A. The pattern of all figures regardless of the starting values is roughly the same.

2.5.2 Determinants of repetition – propensity score estimation

Before turning to the results of the matching estimations, let us first consider the first stage of the matching procedure, the propensity score estimations. These provide some insights about the determinants of grade retention. Appendix B shows the results of these first stage estimations for all specifications, grades and outcomes. While many variables are significant in one or the other case there are two consistent results across (almost) all estimations. First, the mean score of the class increases the likelihood of repetition and an increasing individual test score decreases its risk. Both variables are generally highly significant and seem to be the most important determinants of repetition. This is very reasonable since these variables taken together are a relative measure of the achievement of an individual student relative to her peers: If the mean score of the class is high, the individual score is relatively lower and the risk of grade repetition increases. In contrast, the higher the individual score the better is the student relative to her peers and the higher the chances of promotion. The detailed results of these and all additional variables are shown in Appendix B.

2.5.3 Matching results

As the main interests lie in the effects of retention on educational outcomes given the same number of schooling years since retention, I follow concept (a) for the matching analysis described above. Concept (b) has the limitation that it rather shows the effect of an additional year of schooling than the actual impact of repetition. If we were to find out that repetition according to concept (b) would lead repeaters to achievements comparable to those of non-repeaters by a certain future grade we could still not infer how beneficial repetition has

been indeed as the counterfactual scenario of an additional school year for non-repeaters is missing.

The analysis is started by discarding the time dimension in the panel and by splitting the data into four cross-sections covering the retention decision in grades 2, 3, 4 and 5 respectively (specification 1). This will serve as the baseline specification. Then I report on the results of the specification, including the time trends of the variable *test scores* (specification 2), and after this I discuss the results of the full specification, including time trends for all covariates (specification 3). In all these specifications I follow the logic of concept (a) and report on the outcome variable – the post-treatment test scores – one, two, three and four years after the retention decision where possible.

Table 2.2, partitioned into parts A to D, contains all results for concept (a) – sorted by time of outcome, specification and grade. For the first specification, that is for the cross-sections, the average treatment effect on the treated (ATT) is negative and significant (at the 1% or 5% level) for all grades if the test scores of the following year is used as the outcome. The ATT ranges from -0.37 in grade 2 to -0.87 in grade 4. Looking at the distribution of test scores in the respective grades, the magnitude of most of the significant estimates corresponds to between 20 and 65 percent of a standard deviation of test scores (see Tables 2.1 and 2.2).

Table 2.2: Estimation of the impact of retention on achievement (ATT)

Outcome after		*A: One* year		*B: Two* years		*C: Three* years		*D: Four* years	
		ATT[1]	*N*[2]	*ATT*	*N*	*ATT*	*N*	*ATT*	*N*
Specification 1	Grade 2	-0.37**	109	-0.47**	71	-0.54***	66	-0.64***	56
		(0.17)	(106)	(0.21)	(69)	(0.19)	(61)	(0.17)	(53)
	Grade 3	-0.68***	113	-0.33*	79	-0.41**	59	-	-
		(0.17)	(112)	(0.18)	(77)	(0.21)	(58)		
	Grade 4	-0.87***	50	-0.75***	30	-	-	-	-
		(0.23)	(47)	(0.24)	(26)				
	Grade 5	-0.71***	50	-	-	-	-	-	-
		(0.25)	(44)						
Specification 2	Grade 2	-	-	-	-	-	-	-	-
	Grade 3	-0.64***	104	-0.32*	74	-0.38*	57	-	-
		(0.17)	(101)	(0.19)	(71)	(0.21)	(56)		
	Grade 4	-0.71***	38	-0.30	23	-	-	-	-
		(0.26)	(34)	(0.30)	(19)				
	Grade 5	-0.57**	47	-	-	-	-	-	-
		(0.26)	(42)						
Specification 3	Grade 2	-	-	-	-	-	-	-	-
	Grade 3	-0.70***	89	-0.40*	60	-0.64**	45	-	-
		(0.19)	(83)	(0.21)	(58)	(0.26)	(43)		
	Grade 4	-0.74**	31	-[3)]	-	-	-	-	-
		(0.33)	(24)						
	Grade 5	-0.74*	34	-	-	-	-	-	-
		(0.43)	(14)						

Note: Specification 1 is a cross-sectional analysis that does not include the development path of the control variables. Specification 2 includes the past trend of test scores of the respective student, that is the test score of grade 2 and all subsequent changes of the test score from one grade to the next up to the grade of interest. Specification 3 incorporates the trend of all control variables in the same way as for test scores (see also the propensity score estimations in Appendix B for a complete list of control variables (including trends).

[1)] ATT computed using Stata's PSmatch 2 (Leuven and Sianesi, 2003) reprogrammed in order to estimate the propensity score using a random intercepts model. Standard errors are reported in parentheses.

[2)] Number of observations on support in parentheses.

[3)] Estimation did not converge.

In this specification, students are compared with respect to their socio-economic background, their achievement and the characteristics of teachers and the school in the year at the end of which the repetition decision is taken. According to the results, students who are equal or very similar with respect to these characteristics perform worse in the following year if they are retained than if they are promoted. In other words, even though retained students

are equal to promoted ones regarding a large set of characteristics they will underperform as a result of retention. The size of this impact varies at the grade level with generally more negative effects for higher grades. Moreover, note that in general the number of (on support) observations decreases in each grade due to attrition, that is dropout from school. Further note that in grade 5 I could not include the variables *class size*, *teacher job experience*, *teacher speaks French at home* and *teacher speaks local language* in the estimation of the propensity score as there are no data for these four variables for grade 5. The disadvantage therefore is that there are less reliable ATT estimates for grade 5 as these four variables are likely important covariates that need to be controlled for.[18]

Specifications 2 and 3 should be seen as the most meaningful ones since earlier time periods are considered. Technically speaking, this is equivalent to the inclusion of further covariates that strengthen comparability. We may, however, attribute at least two more advantages to the inclusion of time trends. First, as I include the time *trends*, that is the difference of test scores from one grade to the next in specification 2 and of all covariates in specification 3, I thereby also include a development path for each student rather than merely a snapshot in time. Second, if it is perceived that there are possibly additional (unobserved) covariates that need to be included for better comparability across students, then these covariates are likely to influence the pre-treatment covariates that I include and therefore be part of the set of covariates I control for. This idea is corroborated by the fact that matching is inter alia based on pre-treatment test scores in order to get an estimate for post-treatment test scores. That is, if an additional variable influences post-treatment test scores then it is also likely to influence pre-treatment test scores and possibly also the development of pre-treatment test scores. Also, note that there is no estimation for grade 2 in specifications 2 and

[18] See Table A2 in Appendix A for a list of variables included by grade.

3 as there are no earlier time periods to be included. These two specifications do not differ much from the first specification for test score outcomes after one year. All the estimates of the ATTs are negative, but of smaller size in specification 2 for grades 3 to 5. In grades 3 and 5 of specification 3 they are even larger. The estimate of the grade 5 ATT of specification 3 remains significant only at the 10% level though. The first impression of a negative effect of retention is thus corroborated in the more encompassing specifications 2 and 3. In other words, given that students are equal or very similar based on the characteristics stated above in the first year of the panel as well as based on the development of these characteristics over time until the point of the repetition decision, then those students who repeat perform worse in the following year than those who do not repeat.

These results give insight into the dynamics of achievement in the year immediately following the repetition decision. This could be a special year as the repeating student is now for the first time in her new class with her new peers. Therefore, it is of special interest what the effect of retention will be after two and more years when the student has had time to get accustomed to her new peers and her new environment.

Parts B through D of Table 2.2 contain the ATT estimates for student achievement more than a year after the retention decision. Almost all estimates remain negative and significant albeit only at the 10% level in four cases. Looking at these results for the outcome after more than a year we may infer that repetition has either a clear negative effect at the 5% level or, in some cases, that there is a somewhat weaker evidence of a negative effect at the 10% level or an insignificant effect (in one estimation). It seems clear, however, that following this particular type of comparison based on concept (a), there is no positive effect of repetition visible in the data set.

Let us next investigate changes in the effects over time. For grade 2 the absolute size of the effect continually increases after two (-0.47), three (-0.54) and four years (-0.64), remaining highly significant (at the 1% level for the outcome after three and four years). Starting with a repetition in grade 3, however, the absolute value of the ATT always decreases after two years and remains on a similar level or re-increases after three years. In the case of specifications 2 and 3, it amounts to -0.38 and -0.64 after three years. Grades 4 and 5 reveal considerable sizes for the ATT in all three specifications for the outcome after one year with somewhat smaller coefficient for more distant years. All three specifications show consistency in their prediction whether coefficients will be greater or smaller for a given grade and different time horizons.

In general, it seems that the worsening impact of repetition is not systematically higher or lower based on grade or on the time between repetition and the measurement of achievement. Therefore, the results suggest that, unlike in the studies of Alet (2010) and Jacob and Lefgren (2004, p.235), achievement scores further away are not systematically worse than in the direct aftermath.

How may these varying patterns be explained? It is straightforward to imagine that the grade of repetition is the most difficult one for the student as she will enter a new social group and will have to handle the demotivation stemming from retention and the fact of studying the same subjects again. What happens thereafter is less clear. Possibly, the student has managed to accept the new environment and has made friends. Indeed, the worsening effect after more years for grade 2 in specification 1 may be explained by the reasons stated in the theoretical part of this analysis. Approaching early adolescence age differences may become more evident in physical and emotional form, thus widening the gap between retained and promoted students. These differences could lead to mockery by other students or de-motivate

the over-age student if she believes that she should be in a class of even-aged students. This is also corroborated by the results for higher grades of specification 1. The higher the grade and hence the nearer a student is to adolescence, the worse the negative impact on achievement already after one year (although in grade 5 the coefficient decreases somewhat again). However, specifications 2 and 3 do not support this as in some cases the coefficients decrease with higher grade or for achievements after more years. This may be some evidence for the alternative explanation that for younger students age differences are relatively more pronounced than for older ones and therefore play a particularly negative role. In general, we must be cautious in the interpretation of the effects for more distant years since student dropouts lead to smaller sample sizes, which may be partly relevant for the sizes of the effects.

Based on these estimations we may now attempt to answer if the considerations in the theoretical part of this chapter are reflected in the results. First, does a student perform worse than if she had been promoted or at least just as well? Second, what is the impact of repetition on student achievement over time? For the first question, we can state that grade retention does have a negative impact on achievement as all but one estimation reveal significant negative effects. Referring to the time dimension a clear statement cannot be offered. There is some evidence that the initially very negative effect of repetition in the direct aftermath of the retention decision is mitigated when retention dates back two years just to be reinforced after three years for grade 3. This may suggest that there is a non-linear effect of repetition in time. However, given the negative signs for all coefficients, a positive effect cannot be attributed to retention in any of the specifications and grades.

2.5.4 Robustness checks, further results and simulations

2.5.4.1 Fixed effects and random effects results

To check the results for robustness I estimate fixed effects and random effects regressions. Student fixed effects have the advantage that unobserved time invariant student characteristics are accounted for. That means endogeneity resulting from such variables as innate student ability that are expected to be constant over time are controlled for. If the matching procedure fails to account for these types of variables even though including the development paths of students in relevant observable variables then the fixed effects estimations are likely to show different results. Table 2.3 shows the results from the fixed effects regression and Table 2.4 those of the random effects regression for completeness for test score outcomes after one, two and three years.

The random effects coefficients for repetition are always significantly negative. I will, however, focus on the estimates of the fixed effects regression as the hausman test clearly rejects the hypothesis that the coefficients of the fixed effects and random effects estimations do not differ systematically. In column (1) of Table 2.3 we can see that repetition has a highly significant negative effect on student achievement after one year. However, the coefficients for achievement outcomes after two and three years (columns (2) and (3)) are not significant. Similarly to the results of the matching specifications we can state that repetition has either a negative or an insignificant effect on student achievement. Again there is no indication that there could be a positive effect of grade retention on test scores of students in the following years.

Table 2.3: The effect of repetition on achievement (fixed effects)

	(1)	(2)	(3)
Outcome after	A: One year	B: Two years	C: Three years
repetition	-0.31***	0.01	-0.03
	(0.11)	(0.14)	(0.18)
class size	-0.01***	0.01**	-0.01*
	(0.00)	(0.00)	(0.00)
teacher job experience	-0.00	-0.00	0.01
	(0.00)	(0.01)	(0.01)
test score	-0.26***	-0.23***	0.08
	(0.03)	(0.04)	(0.05)
share math books	-0.34**	0.29**	-0.05
	(0.13)	(0.15)	(0.20)
teacher training	-0.04*	0.01	0.02
	(0.02)	(0.02)	(0.03)
male teacher	-0.04	0.07	0.16
	(0.08)	(0.09)	(0.11)
double shift	-0.07	0.10	0.02
	(0.15)	(0.17)	(0.23)
student age	1.27***	0.86***	0.48***
	(0.06)	(0.06)	(0.08)
teacher speaks local language	-0.16*	0.22**	-0.14
	(0.09)	(0.10)	(0.11)
teacher speaks French at home	-0.04	0.02	0.09*
	(0.03)	(0.04)	(0.05)
property at home	0.01	-0.05	-
	(0.03)	(0.03)	
media availability	0.03	0.13**	-
	(0.06)	(0.06)	
work at home	-0.03	-0.01	-
	(0.02)	(0.03)	
meals	0.24***	0.10	-
	(0.07)	(0.08)	
student speaks French at home	0.09	-0.05	-
	(0.12)	(0.14)	
languages-student	0.04	0.00	-
	(0.07)	(0.09)	
study at home	-0.03	-0.02	-
	(0.07)	(0.08)	
constant	-10.43***	-7.24***	-2.19**
	(0.74)	(0.81)	(0.91)
hausman test (p-value)	0.00	0.00	0.00
observations	2,179	1,848	1,331
R-squared (within)	0.53	0.36	0.24

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 2.4: The effect of repetition on achievement (random effects)

	(1)	(2)	(3)
Outcome after	A: One year	B: Two years	C: Three years
repetition	-0.42***	-0.40***	-0.28***
	(0.08)	(0.09)	(0.10)
mean score of class (grade 2)	0.16***	0.02	-0.05
	(0.05)	(0.06)	(0.06)
share repeaters in class (grade 2)	0.81***	1.50***	2.02***
	(0.31)	(0.34)	(0.39)
class size	-0.01***	0.00	0.00
	(0.00)	(0.00)	(0.00)
teacher job experience	0.00	0.00	0.01
	(0.00)	(0.00)	(0.00)
prior repetition	-0.30***	-0.35***	-0.20**
	(0.07)	(0.08)	(0.10)
test score	0.60***	0.52***	0.55***
	(0.02)	(0.02)	(0.02)
boy	0.05	0.08	0.02
	(0.07)	(0.08)	(0.09)
property at home	0.00	-0.05**	-0.02
	(0.02)	(0.02)	(0.02)
media availability	0.07*	0.15***	0.11**
	(0.04)	(0.04)	(0.05)
share math books	0.03	0.31***	0.16
	(0.09)	(0.10)	(0.11)
city size	0.06*	0.02	-0.06
	(0.04)	(0.04)	(0.05)
teacher training	0.03	0.06***	0.08***
	(0.02)	(0.02)	(0.02)
work at home	-0.00	-0.00	-0.04
	(0.02)	(0.02)	(0.02)
meals	0.02	0.09	0.26
	(0.06)	(0.06)	(0.17)
male teacher	0.07	0.03	-0.01
	(0.06)	(0.06)	(0.07)
double shift	-0.06	0.07	0.08
	(0.07)	(0.08)	(0.09)
student age	0.14***	0.07**	0.01
	(0.03)	(0.03)	(0.04)
student speaks French at home	0.25**	0.23**	0.13
	(0.10)	(0.11)	(0.17)
languages-student	0.11**	0.10*	0.07
	(0.05)	(0.06)	(0.07)
teacher speaks local language	0.00	0.17**	-0.03
	(0.06)	(0.07)	(0.07)

Table 2.4 Continued

Outcome after	(1) A: One year	(2) B: Two years	(3) C: Three years
teacher speaks French at home	-0.05*	-0.02	0.00
	(0.03)	(0.03)	(0.04)
study at home	0.08	-0.00	0.12
	(0.06)	(0.06)	(0.07)
number of students	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)
partnerships	-0.05	0.02	0.08
	(0.04)	(0.05)	(0.05)
teacher meetings	0.05	0.07*	0.07*
	(0.03)	(0.04)	(0.04)
constant	-0.76*	-0.33	0.23
	(0.45)	(0.49)	(0.68)
observations	2,179	1,848	1,331
R-squared (overall)	0.60	0.50	0.49

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

2.5.4.2 Results by initial test scores

Finally, the dynamics after retention may differ depending on the initial achievement of the students before retention (see PASEC, 2004, p.97). In this regard, it may be particularly demotivating for a student with high test scores to be retained. This may lead to worse test scores in the following post-retention years. In comparison to a matched control group this may be even more evident if teachers focus on the good students of their classes supporting the high-achieving promoted students. In contrast, a high-achieving student who is retained may be less affected by the repetition decision if her knowledge is on such a high level that allows her to outweigh the negative consequences of a perceived failure such as grade retention. As we could think of these different effects, the issue is ultimately an empirical one.

Table 2.5: Matching results by initial test score

	Initial test score *below* mean		Initial test score *above* mean	
A: Outcome After *ONE* Year	ATT	N	ATT	N
Grade 2	-0.05	95	-0.83**	14
	(0.18)	(86)	(0.41)	(12)
Grade 3	-0.71***	97	-[1)]	-
	(0.19)	(95)		
Grade 4	-0.63*	33	-1.01***	17
	(0.33)	(31)	(0.31)	(15)
Grade 5	-1.04***	41	-0.87*	9
	(0.28)	(30)	(0.51)	(8)
B: Outcome After *TWO* Years				
Grade 2	-0.38	62	-1.01	9
	(0.25)	(60)	(0.65)	(6)
Grade 3[1]	-0.24	66	-[1)]	-
	(0.20)	(64)		
Grade 4	-0.76**	19	-1.28***	11
	(0.32)	(16)	(0.22)	(5)
C: Outcome After *THREE* Years				
Grade 2	-0.76***	55	-1.13	11
	(0.24)	(51)	(0.71)	(8)
Grade 3[1]	-0.43*	48	-[1)]	-
	(0.22)	(45)		
D: Outcome After *FOUR* Years				
Grade 2	-0.42**	48	-[1)]	-
	(0.18)	(43)		

See Table 2.2 notes. Specification 1 (cross-section) has been chosen for this analysis in order to retain as many observations as possible.
[1)] Estimation did not converge.

Table 2.5 reports the ATTs of those students whose initial test score before repetition is below the mean test score of all students and those repeaters achieving higher than mean scores respectively. These numbers were calculated using specification 1, as it retains more observations than the other specifications and splitting the data set already decreases the number of observation per estimation. The sign of the effect of repetition is always negative and in many cases the effect is significant. In general, fewer cases show significance than in Table 2.2 where all students are analysed together, presumably because of the lower number of observations per estimation after dividing the data set. Comparing both types of students (initially lower- and initially higher-achieving students), there is no systematic difference. In

some grades lower-achieving students have a less negative effect than higher-achieving ones; in grade 5 for the outcome after one year the contrary is observed; and some estimations did not converge or show insignificant negative coefficients. This is in line with PASEC (2004) where interactions between test scores prior to repetition and grade retention were found to be insignificant predictors of subsequent student achievement. It seems that repeating a grade has a negative impact on both types of students without major differences across these groups.

2.5.4.3 Selection and simulations

Selection is potentially a problem in the context of the estimations since many students have dropped out from school during the five years of the panel. The remaining students may be a selection that differs from those who have dropped out and this may bias the estimations. Specifically, repeaters may be more likely to drop out as has been suggested in the literature (see Eide and Showalter, 2001; Jacob and Lefgren, 2009; André, 2012; Glick and Sahn, 2010; Manacorda, 2012) and therefore those repeaters who remain in school are more heavily selected.

There is some reason to believe that the students who drop out may actually have performed worse if they had stayed at school than those who remained in school: If schooling is a cost-benefit consideration as proposed in section 2.2 (see Bedi and Marshall, 2002; Glick and Sahn, 2010), then the anticipation of low test scores in the future might make the opportunity costs of schooling appear too high and lead to dropout. It is difficult to gauge how strong dropouts affect the results as it is not possible to know the test scores they would have attained if they had remained in school. However, the initial motivation of this study was to find out if grade retention potentially has a positive impact on subsequent achievement, which

could justify the costs the education system is burdened with. So far, the matching coefficients of all three specifications have shown negative signs even though in some cases they were not significant. It is likely that these coefficients are an underestimation of the effect of grade retention on student achievement as students may drop out because of their anticipated low achievement in the future. If this is the case, the estimations would give us confidence in the results that grade retention is not favorable in terms of student achievement.

In contrast, if students drop out simply because they have to repeat and therefore do not see the benefit of staying at school they may still have been well-performing students if they had stayed in school. In this case, leaving these students out from the estimations will bias the estimates leading to an overestimation of the negative effect. In fact, the data of this study show that 36 percent of dropouts attain test scores above their class mean for the year prior to dropping out.

The selection problem for the data at hand is special as the information on control variables needed for matching is available for the sub-population of dropouts until the last year they attend school. The only information that is missing is the test score of the year of interest after dropout. To investigate the issue of selection, I therefore run simulations in which I treat students who drop out the following year as repeaters and assign them the average of the test score values of actual repeaters in their class who do not drop out for the period of comparison (e.g. the average test score in the subsequent year of current repeaters if the outcome after one year is considered). Then I gradually increase the test score values that are assigned to the future dropouts by one percentage point in each iteration until the sign of the respective coefficient becomes positive.

Table 2.6 shows the results of this exercise for specification 1. For each year and grade, the respective cell shows by how much dropouts would have to perform better than

repeaters who remain in school to change the coefficient for the ATT to become positive.[19] The percentage increases necessary to change the signs of the coefficients to become positive are between 90 and 258 percent when all students are included. Splitting the data at the mean class score the ranges are between 37 and 227 percent if the initial score is below the mean and between 117 and 331 percent if it is above. The values for the simulations of students with initial test scores below the class mean are generally lower, presumably because there is a greater share of dropouts in this group lending them a stronger weight in the estimations.

The percentage increases are very high and show that the simulated test scores of dropouts would need to be considerably above the average values of repeaters who remain at school to change the general results of a negative effect of repetition on achievement. The reason why these values are so high is that the average share of dropouts per grade is too small in terms of statistical relevance. As shown in the summary statistics of Table 2.1 the share of dropouts per grade varies between relatively low 7 and 14 percent. These numbers on the other hand are very high from the perspective that dropouts accumulate from grade to grade and that all these students drop out of school very early in their lives lacking a profound education. If these high dropout rates are mainly triggered by grade retention, then this is an additional cost to the education system that goes beyond the costs of retaining students without positive effects on their achievement.

[19] However, at the percentage where the estimate for the ATT turns positive the latter is of course highly insignificant and therefore the percentages given are still considered to be conservative values.

Table 2.6: Simulating test scores of students who have dropped out from school

A: Outcome After *ONE* Year	All students	*Initial test score below* mean	*Initial test score above* mean
Grade 2	+ 92%	+ 37%	+ 129%
Grade 3	+ 258%	+ 227%	+ 331%
Grade 4	+ 191%	+ 118%	+ 303%
Grade 5	-	-	-
B: Outcome After *TWO* Years			
Grade 2	+ 153%	+ 91%	+ 225%
Grade 3	+ 149%	+ 75%	+ 198%
Grade 4	+ 159%	+ 110%	+ 267%
C: Outcome After *THREE* Years			
Grade 2	+ 185%	+ 187%	+ 301%
Grade 3	+ 90%	+ 65%	+ 117%
D: Outcome After *FOUR* Years			
Grade 2	+ 167%	+ 101%	+ 237%

Note: In this simulation students who drop out the subsequent year are treated as if they had been told to repeat at the end of the current year (where we cannot observe the actual repetition decision any more). They are assigned the average respective test score value of the repeaters in their class who remain in school in the subsequent year. This value is gradually increased until the respective estimate for the ATT turns positive. The percentages show by how much the simulated test scores of dropouts have to be higher than the actual test scores of repeaters who remain in school to attain a positive value for the estimate. At this level the respective estimate is highly insignificant.

2.6 Conclusion

In this analysis I have researched the dynamics of retention over time for a variety of grades and specifications. I have used a unique data set that follows a large number of Senegalese primary students for five consecutive years starting in grade 2. It includes a large variety of relevant variables on the socio-economic background of the students as well as on

their teachers and schools. In accordance with the literature on repetition in Francophone Sub-Saharan Africa, the results suggest that retention does not offer the expected benefits regarding student achievement in Senegal and cannot, therefore, counterbalance the increased costs the education system is burdened with. I have used descriptive graphic evaluation on the one hand and inferential statistical analysis on the other for the analysis. The statistical part consisted of propensity score matching that calculates the propensity score by a multi-level logit function, including the development of student test scores over time and variables detailing student, teacher and school characteristics as covariates. The results are tested for robustness in fixed effect and random effects estimations. In a preliminary analysis there was no evidence that repeaters are systematically selected into different classes than promoted students. I did, however, control for the possibility that sorting appears on the class level, i.e. that classes with certain characteristics such as high average test scores or a high share of repeaters may pursue a different path to classes with low score averages or a low share of repeaters. The results of these analyses and their robustness checks suggest that grade retention has a significant negative (or in some cases an insignificant) effect on student achievement in the year directly following retention as well as for more distant years. A significant positive effect of grade retention that could justify the costs of high repetition rates was not found in any of the specifications controlling for a wide range of relevant control variables independent of the number of years passed after the retention decision.

Against the backdrop of the aims of the EFA initiative and the Millennium Development Goals these results appear highly relevant. The goal of universal primary education of high quality is ambitious and will be even more so if the education system gets overcrowded because of repetition. Using a rich data set with detailed information on students, teachers and schools in Senegal I employed elaborate statistical methods to show

that, in the context of Francophone Sub-Saharan Africa, there is little to expect from a retention policy that promotes high repetition rates with respect to educational quality (measured as student achievement) even beyond the year directly following the retention decision. This example from Senegalese primary schools is also highly relevant for other Francophone Sub-Saharan African countries where repetition rates remain high.

Appendix A: Additional evidence and variable definitions

Figure A1: Relationship between share of repeaters and mean score of non-repeaters per class

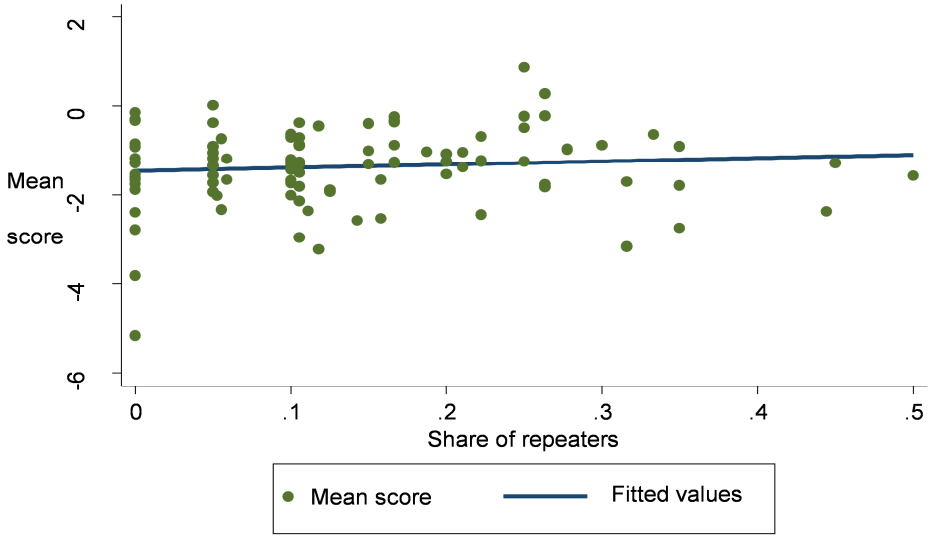


Figure A2: Relationship between share of repeaters and mean score of repeaters per class

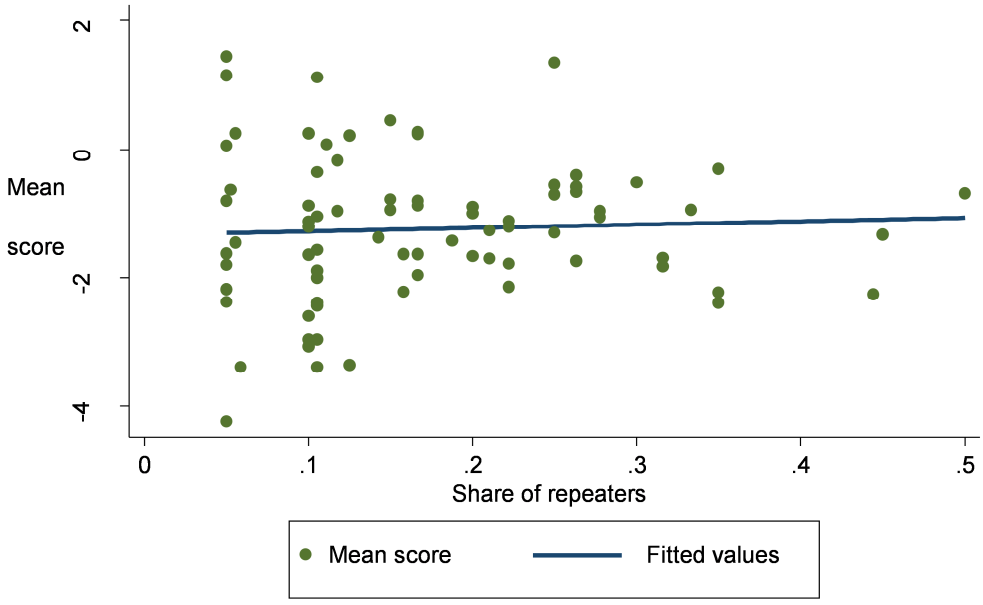


Figure A3: Relationship between share of repeaters and standard deviation of scores per class

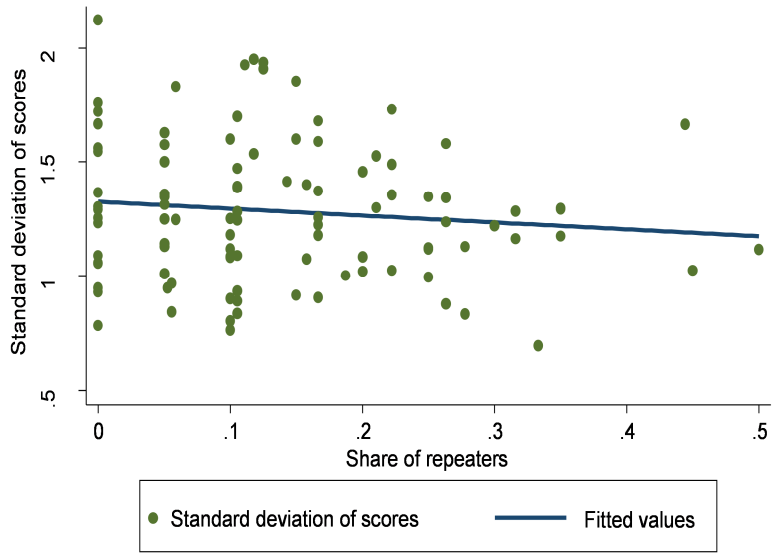
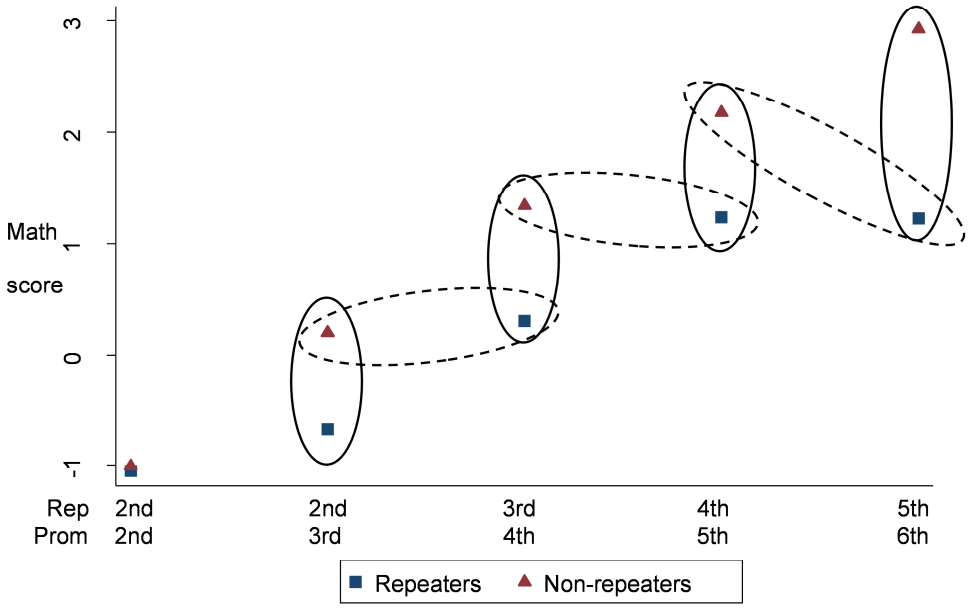
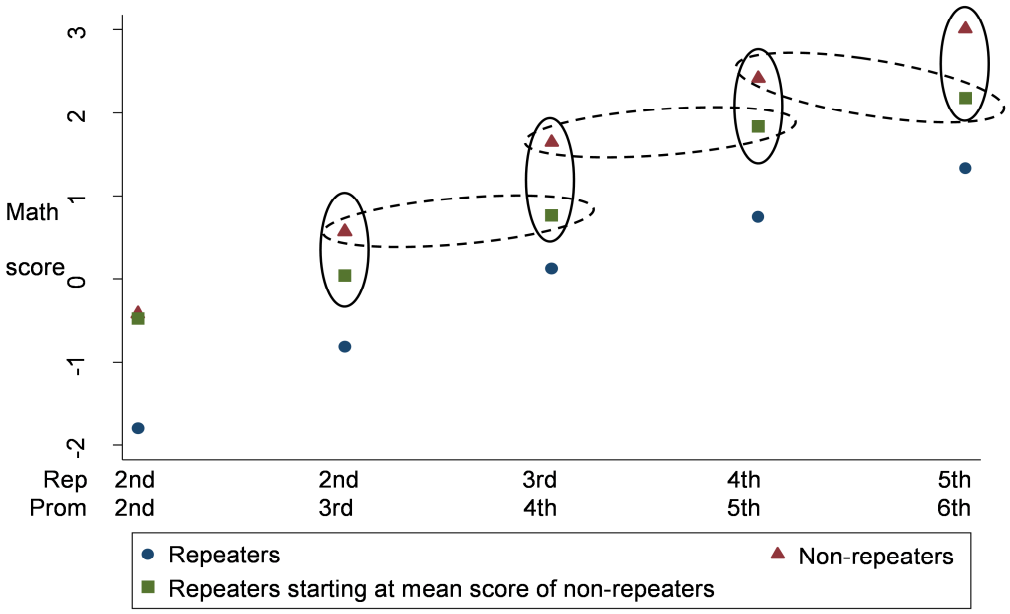


Figure A4: Comparing retained and promoted students (II)



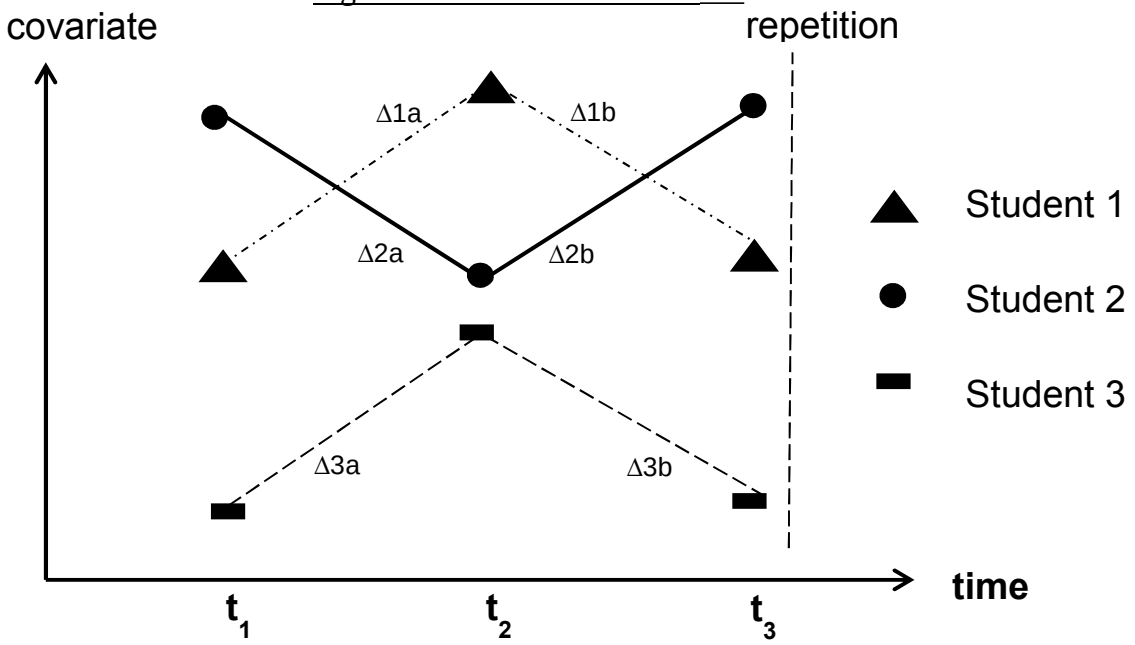
The circles encompass the observations to be compared. The solid circles represent concept (a): The students compared have the same amount of schooling since the point of the repetition decision. The dashed circles represent concept (b): A grade 2 repeater when in grade 3 is compared to a promoted student when in grade 3, etc. N=9 for repeaters and N=88 for non-repeaters. Starting point is approximately the mean between the mean of the repeaters and the mean of non-repeaters (maximum 0.5 greater or smaller than this value).

Figure A5: Comparing retained and promoted students (III)



The circles encompass the observations to be compared. The solid circles represent concept (a): The students compared have the same amount of schooling since the point of the repetition decision. The dashed circles represent concept (b): A grade 2 repeater when in grade 3 is compared to a promoted student when in grade 3, etc. N=7 for repeaters starting at mean score of non-repeaters (maximum half a std.dev. greater or smaller than this value) and N=308 for non-repeaters.

Figure A6: Allocation of matches



According to specifications 2 and 3, students are matched based on the value of the covariate(s) in t1 and based on the changes from one grade to the next (Δ1a, Δ1b etc.). In this example, student 1 is matched to student 3 even though each data point of student 2 is closer to that of student 1. The idea is that the development path (Δ) is the most important criterion.

Appendix A: Additional evidence and variable definitions

Table A1: Variable description

repetition	dummy (student repeats current year=1, else=0)
mean score of class (grade 2)	mean of test scores of second graders in first year of panel
share repeaters in class (grade 2)	share of repeaters of second grade in first year of panel
class size	number of students per class
teacher job experience	number of years of teaching experience
prior repetition	number of grade retentions including current year
test scores	math test scores
boy	dummy (male student=1, female student=0)
property at home	(0,…,7) student's family possessions (car, fridge, flush toilet, electricity, water tap, armchair and kitchen with gas=7, all of these but one=6, …, none of these=0)
media availability	(0,…,3) student's family possessions (TV, radio and video=3, all of these but one=2, one of these=1, none of these=0)
share math books	(0-1) share of math textbooks in class
city size	school location (small village=1, big village=2, suburb of big city=3, town=4)
teacher training	(0,…,5) duration of teacher training (more than one year of training=5, one year of training=4, 6 months of training=3, 1–3 months of training=2, less than one month of training=1, no training=0)
work at home	(0,…,8) work activities of student outside the school (cooking, cleaning, laundry, field work, animal husbandry, dishwashing, childcare and commercial=8, all of these but one=7,…, none of these=0)
meals	(0,…,3) student meals (breakfast, lunch and dinner on regular basis=3, all of these but one=2, one of these=1, none of these=0)
male teacher	dummy (male teacher=1, female teacher=0)
double shift	dummy (several classes using the same room at different times of the day=1, else=0)
student age	age of student
student speaks French at home	dummy (student speaks French at home=1, else=0)
languages-student	(0,…,7) number of languages other than French the student speaks with his or her parents (Wolof, Pulaar, Serer, Diola, Soninke, Mandinka, other)
teacher speaks local language	dummy (teacher speaks local language =1, else =0)
teacher speaks French at home	(1,…,4) teacher speaks French at home (never=1, rarely=2, often=3, almost always=4)
study at home	(0,1,2) student studies at home and gets help with studies at home=0, student studies at home or gets help with studies at home=1, neither of the two=0
number of students	sum of students in the first six grades of the school
partnerships	number of partnerships of the school (with a foreign school, with an NGO or other aid organization, with a bilateral co-operation (Italian, French, German…)
teacher meetings	(0,…,4) frequency of meetings between the director and all the teachers in the school (never=0, at least once per week=1, about once a month=2, about once per trimester=3, about once a year=4)

Table A2: Variables included in the specific matching estimations

Grade 2	**Grade 3**	**Grade 4**	**Grade 5**
mean score of class (grade 2)	mean score of class (grade 2)	mean score of class (grade 3)	mean score of class (grade 4)
share repeaters in class (grade 2)	share repeaters in class (grade 2)	share repeaters in class (grade 2)	share repeaters in class (grade 2)
prior repetition	prior repetition	prior repetition	prior repetition
test scores	test scores	test scores	test scores
boy	Boy	boy	boy
property at home	property at home	property at home	property at home
media availability	media availability	仏edia availability	media availability
share math books	share math books	share math books	share math books
city size	city size	city size	city size
teacher training	teacher training	teacher training	teacher training
work at home	work at home	work at home	work at home
meals	meals	meals	meals
male teacher	male teacher	male teacher	male teacher
double shift	double shift	double shift	double shift
student age	student age	student age	student age
student speaks French at home	student speaks French at home	student speaks French at home	student speaks French at home
languages-student	languages-student	languages-student	languages-student
study at home	study at home	study at home	study at home
number of students	number of students	number of students	number of students
partnerships	partnerships	partnerships	partnerships
teacher meetings	teacher meetings	teacher meetings	teacher meetings
teacher speaks local language	teacher speaks local language	teacher speaks local language	
teacher speaks French at home	teacher speaks French at home	teacher speaks French at home	
class size	class size	class size	
teacher job experience	teacher job experience	teacher job experience	

Note that the variable *mean score of class* differs across grades and further note that four variables were not available for grade 5. In specification 2 the test score of the first year of the panel was included in addition to the change from one grade to the next up to the grade of analysis. In specification 3 this was done for all variables.

Appendix B: Estimations for calculations of propensity scores

Table B1.1: Multi-level logit estimation of grade retention – Specification 1/Grade 2

Grade retention	One year	Two years	Three years	Four years
mean score of class (grade 2)	1.56***	1.83***	1.60***	1.43***
	(0.32)	(0.45)	(0.43)	(0.44)
share repeaters in class (grade 2)	2.11	2.56	3.15	2.76
	(1.75)	(2.30)	(2.43)	(2.48)
class size	0.00	-0.01	-0.01	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)
teacher job experience	0.00	0.02	0.01	0.01
	(0.03)	(0.03)	(0.03)	(0.04)
prior repetition	-0.28	-0.68	-0.79	-0.74
	(0.37)	(0.50)	(0.55)	(0.55)
test score	-1.45***	-1.58***	-1.34***	-1.27***
	(0.16)	(0.22)	(0.19)	(0.20)
boy	-0.08	-0.54	-0.38	-0.26
	(0.34)	(0.43)	(0.43)	(0.48)
property at home	-0.06	-0.17	-0.04	0.03
	(0.10)	(0.13)	(0.12)	(0.13)
media availability	-0.21	-0.09	-0.07	-0.15
	(0.19)	(0.23)	(0.24)	(0.27)
share math books	-1.46*	-1.46	-1.24	-1.41
	(0.77)	(1.06)	(1.07)	(1.13)
city size	0.65***	0.61**	0.41	0.49
	(0.24)	(0.31)	(0.30)	(0.31)
teacher training	0.35**	0.50**	0.29	0.43*
	(0.16)	(0.20)	(0.21)	(0.24)
work at home	-0.09	-0.18	-0.04	-0.07
	(0.09)	(0.12)	(0.12)	(0.14)
meals	0.56	-0.25	-0.79	-0.50
	(0.62)	(0.81)	(0.79)	(0.75)
male teacher	0.18	0.73	0.30	0.34
	(0.38)	(0.52)	(0.53)	(0.54)
double shift	-0.33	-0.26	-0.06	0.24
	(0.45)	(0.62)	(0.61)	(0.63)
student age	-0.02	0.15	0.23	0.38
	(0.18)	(0.24)	(0.24)	(0.27)
student speaks French at home	-0.75	-1.15	0.47	-22.09
	(0.90)	(1.20)	(0.92)	(41028.32)
languages-student	-0.03	-0.18	-0.02	0.13
	(0.27)	(0.34)	(0.36)	(0.39)
teacher speaks local language	-0.21	-0.25	-0.12	0.00
	(0.36)	(0.48)	(0.48)	(0.51)
teacher speaks French at home	-0.29	-0.18	-0.27	-0.28
	(0.25)	(0.33)	(0.33)	(0.33)
study at home	-0.06	0.02	0.04	0.32
	(0.32)	(0.38)	(0.38)	(0.47)
number of students	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
partnerships	0.14	-0.08	0.16	0.43
	(0.25)	(0.33)	(0.34)	(0.34)

Table B1.1 Continued

Grade retention	One year	Two years	Three years	Four years
teacher meetings	-0.04	-0.08	0.12	0.13
	(0.21)	(0.26)	(0.27)	(0.29)
constant	-5.32*	-5.42	-4.22	-7.76*
	(2.98)	(4.06)	(3.84)	(4.20)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. In column 1 the estimation correctly classifies about 99% of non-repeaters and about 12% of repeaters. In column 2, it correctly classifies about 99% and 12% respectively. In column 3, it correctly classifies about 99% and 12% respectively. In column 4, it correctly classifies about 99% and 12% respectively.

Table B1.2: Multi-level logit estimation of grade retention – Specification 1/Grade 3

Grade retention	One year	Two years	Three years	Four years
mean score of class (grade 2)	1.23***	1.51***	1.06**	-
	(0.36)	(0.49)	(0.47)	
share repeaters in class (grade 2)	4.40**	5.52**	5.56**	-
	(1.74)	(2.36)	(2.41)	
class size	0.03*	0.06**	0.06**	-
	(0.02)	(0.03)	(0.02)	
teacher job experience	-0.07**	-0.09**	-0.07*	-
	(0.03)	(0.04)	(0.04)	
prior repetition	0.07	0.33	0.28	-
	(0.32)	(0.37)	(0.42)	
test score	-1.13***	-1.13***	-1.13***	-
	(0.14)	(0.17)	(0.20)	
boy	-0.01	0.07	-0.61	-
	(0.32)	(0.38)	(0.43)	
property at home	-0.03	-0.01	-0.10	-
	(0.10)	(0.13)	(0.14)	
media availability	0.00	-0.18	-0.08	-
	(0.19)	(0.23)	(0.28)	
share math books	0.20	0.25	0.60	-
	(0.52)	(0.66)	(0.67)	
city size	0.49*	0.58*	1.01***	-
	(0.25)	(0.32)	(0.34)	
teacher training	0.19	0.21	0.42**	-
	(0.15)	(0.19)	(0.21)	
work at home	-0.04	0.04	-0.25*	-
	(0.09)	(0.11)	(0.14)	
meals	0.03	0.52	1.29	-
	(0.57)	(0.72)	(0.90)	
male teacher	0.23	0.31	1.36**	-
	(0.39)	(0.51)	(0.59)	
double shift	0.53	1.01	0.40	-
	(0.48)	(0.71)	(0.68)	
student age	0.31*	0.23	0.58**	-
	(0.18)	(0.22)	(0.25)	
student speaks French at home	-22.40	-22.28	-19.86	-
	(37642.39)	(46859.57)	(18745.89)	
languages-student	0.43*	0.37	0.48	-
	(0.25)	(0.32)	(0.36)	
teacher speaks local language	-0.22	0.10	-0.50	-
	(0.57)	(0.74)	(0.78)	
teacher speaks French at home	0.13	0.19	0.63**	-
	(0.22)	(0.28)	(0.30)	
study at home	-0.57**	-0.69**	-0.96***	-
	(0.26)	(0.30)	(0.34)	
number of students	0.00**	0.00**	0.00***	-
	(0.00)	(0.00)	(0.00)	
partnerships	0.31	0.43	0.44	-
	(0.26)	(0.34)	(0.33)	
teacher meetings	0.24	0.05	0.04	-
	(0.22)	(0.29)	(0.28)	
constant	-7.23**	-9.21**	-16.41***	-
	(2.91)	(3.73)	(4.56)	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. In column 1 the estimation correctly classifies about 97% of non-repeaters and about 25% of repeaters. In column 2, it correctly classifies about 97% and 25% respectively. In column 3, it correctly classifies about 97% and 25% respectively.

Table B1.3: Multi-level logit estimation of grade retention – Specification 1/Grade 4

Grade retention	One year	Two years	Three years	Four years
mean score of class (grade 3)	0.27	0.06	-	-
	(0.36)	(0.45)		
share repeaters in class (grade 2)	-2.25	-6.92**	-	-
	(2.26)	(3.09)		
class size	0.03	0.01	-	-
	(0.02)	(0.03)		
teacher job experience	-0.03	-0.02	-	-
	(0.03)	(0.03)		
prior repetition	0.48	1.06**	-	-
	(0.42)	(0.53)		
test score	-0.51***	-0.35*	-	-
	(0.15)	(0.18)		
boy	-0.51	-0.77	-	-
	(0.41)	(0.55)		
property at home	-0.11	-0.15	-	-
	(0.11)	(0.14)		
media availability	0.00	0.11	-	-
	(0.24)	(0.32)		
share math books	-0.47	-0.84	-	-
	(0.76)	(0.94)		
city size	0.28	0.22	-	-
	(0.33)	(0.40)		
teacher training	0.01	-0.02	-	-
	(0.15)	(0.17)		
work at home	-0.13	-0.25*	-	-
	(0.11)	(0.14)		
meals	-0.49	-0.67	-	-
	(0.42)	(0.50)		
male teacher	0.52	0.37	-	-
	(0.50)	(0.60)		
double shift	-0.35	-0.20	-	-
	(0.57)	(0.67)		
student age	0.25	-0.16	-	-
	(0.23)	(0.31)		
student speaks French at home	-0.48	0.48	-	-
	(0.63)	(0.79)		
languages-student	-0.33	-1.34**	-	-
	(0.36)	(0.53)		
teacher speaks local language	-0.60	-0.28	-	-
	(0.57)	(0.69)		
teacher speaks French at home	-0.02	0.50	-	-
	(0.29)	(0.34)		
study at home	-0.40	-0.71*	-	-
	(0.30)	(0.38)		
number of students	0.00	0.00	-	-
	(0.00)	(0.00)		
partnerships	0.09	-0.07	-	-
	(0.34)	(0.38)		
teacher meetings	-0.15	-0.32	-	-
	(0.24)	(0.28)		
constant	-2.80	3.68	-	-
	(2.89)	(3.98)		

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. In column 1 the estimation correctly classifies about 100% of non-repeaters and about 6% of repeaters. In column 2, it correctly classifies about 100% and 6% respectively.

Table B1.4: Multi-level logit estimation of grade retention – Specification 1/Grade 5

Grade retention	One year	Two years	Three years	Four years
mean score of class (grade 4)	0.61	-	-	-
	(0.55)			
share repeaters in class (grade 2)	-0.02	-	-	-
	(3.86)			
prior repetition	0.80	-	-	-
	(0.68)			
test score	-1.26***	-	-	-
	(0.28)			
boy	0.17	-	-	-
	(0.67)			
property at home	-0.05	-	-	-
	(0.17)			
media availability	-0.48	-	-	-
	(0.41)			
share math books	-0.22	-	-	-
	(1.00)			
city size	-0.22	-	-	-
	(0.47)			
teacher training	0.18	-	-	-
	(0.32)			
work at home	0.08	-	-	-
	(0.17)			
meals	-1.46**	-	-	-
	(0.66)			
male teacher	-0.42	-	-	-
	(0.95)			
double shift	-2.06	-	-	-
	(1.31)			
student age	-0.37	-	-	-
	(0.35)			
student speaks French at home	-0.92	-	-	-
	(0.98)			
languages-student	-1.45**	-	-	-
	(0.59)			
study at home	-0.68	-	-	-
	(0.55)			
number of students	0.00	-	-	-
	(0.00)			
partnerships	0.17	-	-	-
	(0.54)			
teacher meetings	-0.42	-	-	-
	(0.45)			
constant	9.63*	-	-	-
	(5.19)			

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. The estimation correctly classifies about 98% of non-repeaters and about 36% of repeaters.

Table B2.1: Multi-level logit estimation of grade retention – Specification 2/Grade 3

Grade retention	One year	Two years	Three years	Four years
mean score of class (grade 2)	1.55***	1.67***	1.28***	-
	(0.39)	(0.47)	(0.47)	
share repeaters in class (grade 2)	3.71**	4.22*	4.51**	-
	(1.77)	(2.21)	(2.28)	
class size	0.04**	0.07***	0.06***	-
	(0.02)	(0.02)	(0.02)	
teacher job experience	-0.06*	-0.07*	-0.06*	-
	(0.03)	(0.04)	(0.04)	
prior repetition	0.14	0.44	0.33	-
	(0.33)	(0.38)	(0.44)	
test score (grade 2)	-1.31***	-1.29***	-1.25***	-
	(0.17)	(0.20)	(0.22)	
test score (difference grades 2/3)	-0.82***	-0.82***	-0.75***	-
	(0.17)	(0.20)	(0.22)	
boy	-0.04	0.00	-0.56	-
	(0.33)	(0.38)	(0.43)	
property at home	-0.10	-0.10	-0.18	-
	(0.11)	(0.13)	(0.14)	
media availability	0.04	-0.16	-0.02	-
	(0.19)	(0.23)	(0.27)	
share math books	0.17	0.43	0.73	-
	(0.53)	(0.62)	(0.65)	
city size	0.56**	0.57*	1.02***	-
	(0.26)	(0.31)	(0.33)	
teacher training	0.21	0.30*	0.43**	-
	(0.15)	(0.18)	(0.20)	
work at home	-0.03	0.00	-0.27*	-
	(0.09)	(0.11)	(0.14)	
meals	0.23	0.91	1.50	-
	(0.61)	(0.81)	(0.93)	
male teacher	0.24	0.16	1.25**	-
	(0.41)	(0.49)	(0.56)	
double shift	0.51	0.96	0.51	-
	(0.49)	(0.67)	(0.67)	
student age	0.30	0.24	0.51**	-
	(0.19)	(0.22)	(0.25)	
student speaks French at home	-22.35	-21.49	-20.15	-
	(36840.60)	(33934.99)	(21313.36)	
languages-student	0.38	0.36	0.48	-
	(0.26)	(0.31)	(0.35)	
teacher speaks local language	-0.13	0.10	-0.40	-
	(0.61)	(0.72)	(0.75)	
teacher speaks French at home	0.20	0.26	0.67**	-
	(0.23)	(0.26)	(0.28)	
study at home	-0.47	-0.55*	-1.03***	-
	(0.29)	(0.32)	(0.35)	
number of students	0.00**	0.00**	0.00***	-
	(0.00)	(0.00)	(0.00)	

Table B2.1 Continued

Grade retention	One year	Two years	Three years	Four years
partnerships	0.36	0.48	0.52	-
	(0.27)	(0.33)	(0.32)	
teacher meetings	0.15	-0.06	-0.03	-
	(0.23)	(0.27)	(0.27)	
constant	-8.33***	-11.08***	-16.51***	-
	(3.13)	(3.96)	(4.59)	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. In column 1 the estimation correctly classifies about 97% of non-repeaters and about 19% of repeaters. In column 2, it correctly classifies about 97% and 19% respectively. In column 3, it correctly classifies about 97% and 19% respectively.

Table B.2.2: Multi-level logit estimation of grade retention – Specification 2/Grade 4

Grade retention	One year	Two years	Three years	Four years
mean score of class (grade 3)	0.24	0.30	-	-
	(0.41)	(0.66)		
share repeaters in class (grade 2)	-3.60	-8.77**	-	-
	(2.54)	(4.38)		
class size	0.02	-0.01	-	-
	(0.02)	(0.03)		
teacher job experience	-0.04	-0.02	-	-
	(0.03)	(0.04)		
prior repetition	0.27	1.38**	-	-
	(0.49)	(0.65)		
test score (grade 2)	-0.67***	-0.87***	-	-
	(0.20)	(0.30)		
test score (difference grades 2/3)	-0.80***	-1.12***	-	-
	(0.25)	(0.35)		
test score (difference grades 3/4)	-0.13	-0.05	-	-
	(0.20)	(0.29)		
boy	-0.43	-0.86	-	-
	(0.45)	(0.67)		
property at home	-0.04	-0.05	-	-
	(0.12)	(0.16)		
media availability	0.06	0.03	-	-
	(0.28)	(0.36)		
share math books	0.15	0.01	-	-
	(0.81)	(1.21)		
city size	0.15	-0.02	-	-
	(0.35)	(0.52)		
teacher training	0.05	0.10	-	-
	(0.16)	(0.22)		
work at home	-0.06	-0.21	-	-
	(0.11)	(0.17)		
meals	-0.21	-0.21	-	-
	(0.48)	(0.64)		
male teacher	0.59	0.59	-	-
	(0.52)	(0.76)		
double shift	-0.69	-0.74	-	-
	(0.64)	(0.91)		
student age	0.31	-0.26	-	-
	(0.26)	(0.41)		
student speaks French at home	-0.20	0.96	-	-
	(0.65)	(0.91)		
languages-student	-0.15	-1.30*	-	-
	(0.35)	(0.67)		
teacher speaks local language	-0.81	-0.93	-	-
	(0.60)	(0.82)		
teacher speaks French at home	0.32	1.19**	-	-
	(0.31)	(0.49)		

Table B.2.2 Continued

Grade retention	One year	Two years	Three years	Four years
study at home		-0.57*	-0.68	-
		(0.32)	(0.43)	
number of students		0.00	0.00	-
		(0.00)	(0.00)	
partnerships		0.02	-0.40	-
		(0.35)	(0.49)	
teacher meetings		0.09	0.06	-
		(0.25)	(0.35)	
constant		-5.58*	1.36	-
		(3.23)	(5.19)	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. In column 1 the estimation correctly classifies about 100% of non-repeaters and about 10% of repeaters. In column 2, it correctly classifies about 100% and 10% respectively.

Table B2.3: Multi-level logit estimation of grade retention – Specification 2/Grade 5

Grade retention	One year	Two years	Three years	Four years
mean score of class (grade 4)	1.57**	-	-	-
	(0.68)			
share repeaters in class (grade 2)	-1.28	-	-	-
	(4.26)			
prior repetition	0.78	-	-	-
	(0.77)			
test score (grade 2)	-2.26***	-	-	-
	(0.48)			
test score (difference grades 2/3)	-2.22***	-	-	-
	(0.51)			
test score (difference grades 3/4)	-1.42***	-	-	-
	(0.41)			
test score (difference grades 4/5)	-0.72**	-	-	-
	(0.30)			
boy	0.25	-	-	-
	(0.76)			
property at home	0.09	-	-	-
	(0.19)			
media availability	-0.55	-	-	-
	(0.47)			
share math books	0.07	-	-	-
	(1.10)			
city size	-0.25	-	-	-
	(0.51)			
teacher training	0.23	-	-	-
	(0.35)			
work at home	0.02	-	-	-
	(0.19)			
meals	-1.82**	-	-	-
	(0.76)			
male teacher	-0.45	-	-	-
	(1.04)			
double shift	-2.51	-	-	-
	(1.65)			
student age	-0.37	-	-	-
	(0.40)			
student speaks French at home	-0.80	-	-	-
	(1.06)			
languages-student	-1.43**	-	-	-
	(0.65)			
study at home	-0.18	-	-	-
	(0.62)			
number of students	0.00	-	-	-
	(0.00)			
partnerships	0.35	-	-	-
	(0.57)			
teacher meetings	-0.57	-	-	-
	(0.50)			
constant	8.27	-	-	-
	(5.78)			

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. The estimation correctly classifies about 98% of non-repeaters and about 43% of repeaters.

Table B3.1: Multi-level logit estimation of grade retention – Specification 3/Grade 3

Grade retention	One year	Two years	Three years	Four years
mean score of class (grade 2)	1.90***	2.10***	3.29***	-
	(0.39)	(0.48)	(0.83)	
share repeaters in class (grade 2)	4.03**	4.65*	4.87	-
	(1.97)	(2.43)	(3.06)	
class size (grade 2)	0.05**	0.08***	0.08**	-
	(0.02)	(0.03)	(0.03)	
class size (difference grades 2/3)	0.02	0.06**	0.05	-
	(0.02)	(0.03)	(0.04)	
teacher job experience (grade 2)	-0.01	-0.03	0.05	-
	(0.04)	(0.05)	(0.06)	
teacher job experience (difference grades 2/3)	-0.06*	-0.10**	-0.16***	
	(0.03)	(0.04)	(0.06)	
prior repetition	0.04	0.37	0.01	-
	(0.36)	(0.43)	(0.54)	
test score (grade 2)	-1.42***	-1.29***	-1.54***	-
	(0.18)	(0.20)	(0.28)	
test score (difference grades 2/3)	-0.90***	-0.95***	-1.08***	-
	(0.18)	(0.21)	(0.27)	
boy	0.13	0.31	-0.17	-
	(0.36)	(0.43)	(0.57)	
property at home (grade 2)	-0.05	-0.02	-0.18	-
	(0.12)	(0.14)	(0.20)	
media availability (grade 2)	-0.02	-0.25	-0.20	-
	(0.19)	(0.24)	(0.31)	
share math books (grade 2)	0.54	1.08	2.27*	-
	(0.70)	(0.87)	(1.29)	
share math books (difference grades 2/3)	-1.40*	-1.20	-3.63**	-
	(0.74)	(0.92)	(1.70)	
city size (grade 2)	0.97***	0.93***	1.62***	-
	(0.29)	(0.35)	(0.49)	
teacher training (grade 2)	0.55**	0.40	0.49	-
	(0.27)	(0.31)	(0.42)	
teacher training (difference grades 2/3)	0.08	-0.01	-0.25	-
	(0.16)	(0.20)	(0.33)	
work at home (grade 2)	0.04	0.13	-0.19	-
	(0.10)	(0.13)	(0.18)	
meals (grade 2)	-0.22	0.39	1.03	-
	(0.64)	(0.80)	(1.05)	
male teacher (grade 2)	1.62***	1.71***	3.89***	-
	(0.50)	(0.62)	(1.15)	
male teacher (difference grades 2/3)	-0.21	-0.13	2.32**	-
	(0.46)	(0.60)	(1.02)	
double shift (grade 2)	1.07*	1.40*	1.24	-
	(0.58)	(0.74)	(1.00)	
double shift (difference grades 2/3)	1.46	3.13**	5.88***	-
	(0.96)	(1.35)	(2.28)	
student age	0.35*	0.22	0.59**	-
	(0.20)	(0.24)	(0.30)	
student speaks French at home (grade 2)	-22.57	-21.85	-23.74	-
	(25254.83)	(31962.19)	(91145.02)	

Table B3.1 Continued

Grade retention	One year	Two years	Three years	Four years
languages-student (grade 2)	0.55**	0.61*	0.87**	-
	(0.27)	(0.32)	(0.41)	
teacher speaks local language (grade 2)	1.77**	2.44**	3.87**	-
	(0.82)	(1.02)	(1.64)	
teacher speaks local language (difference grades 2/3)	1.42*	2.12**	3.81**	-
	(0.77)	(0.94)	(1.59)	
teacher speaks French at home (grade 2)	0.57	0.30	1.15*	-
	(0.36)	(0.42)	(0.63)	
teacher speaks French at home (difference grades 2/3)	0.02	-0.01	0.13	-
	(0.24)	(0.28)	(0.37)	
study at home (grade 2)	-0.74**	-0.93**	-2.05***	-
	(0.35)	(0.40)	(0.53)	
number of students	0.00***	0.00***	-0.01***	-
	(0.00)	(0.00)	(0.00)	
partnerships	0.46*	0.53	0.43	-
	(0.26)	(0.33)	(0.41)	
teacher meetings	0.20	0.06	0.23	-
	(0.22)	(0.26)	(0.31)	
constant	-14.27***	-15.06***	-23.97***	-
	(3.99)	(4.90)	(7.02)	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. In column 1 the estimation correctly classifies about 97% of non-repeaters and about 27% of repeaters. In column 2, it correctly classifies about 97% and 27% respectively. In column 3, it correctly classifies about 97% and 27% respectively.

Table B3.2: Multi-level logit estimation of grade retention – Specification 3/Grade 4

Grade retention	One year	Two years	Three years	Four years
mean score of class (grade 2)	-0.86	-	-	-
	(0.98)			
mean score of class (difference grades 2/3)	-0.84	-	-	-
	(1.06)			
share repeaters in class (grade 2)	-16.53**	-	-	-
	(7.24)			
class size (grade 2)	0.16*	-	-	-
	(0.09)			
class size (difference grades 2/3)	0.06	-	-	-
	(0.07)			
class size (difference grades 3/4)	0.03	-	-	-
	(0.08)			
teacher job experience (grade 2)	-0.01	-	-	-
	(0.14)			
teacher job experience (grades 2/3)	0.02	-	-	-
	(0.09)			
teacher job experience (grades 3/4)	-0.01	-	-	-
	(0.10)			
prior repetition	0.33	-	-	-
	(0.68)			
test score (grade 2)	-1.19***	-	-	-
	(0.32)			
test score (difference grades 2/3)	-0.88**	-	-	-
	(0.37)			
test score (difference grades 3/4)	-0.24	-	-	-
	(0.26)			
boy	0.07	-	-	-
	(0.85)			
property at home (grade 2)	0.11	-	-	-
	(0.26)			
property at home (difference grades 3/4)	0.22	-	-	-
	(0.20)			
media availability (grade 2)	-0.12	-	-	-
	(0.47)			
media availability (difference grades 3/4)	0.08	-	-	-
	(0.38)			
share math books (grade 2)	3.11	-	-	-
	(3.42)			
share math books (difference grades 2/3)	0.17	-	-	-
	(2.67)			
share math books (difference grades 3/4)	3.91	-	-	-
	(4.07)			
city size (grade 2)	0.78	-	-	-
	(1.21)			
teacher training (grade 2)	1.87***	-	-	-
	(0.63)			
teacher training (difference grades 2/3)	1.29*	-	-	-
	(0.68)			
teacher training (difference grades 3/4)	0.53	-	-	-
	(0.38)			
work at home (grade 2)	0.07	-	-	-
	(0.27)			

Table B3.2 Continued

Grade retention	One year	Two years	Three years	Four years
work at home (difference grades 3/4)	-0.03	-	-	-
	(0.17)			
meals (grade 2)	-0.11	-	-	-
	(1.58)			
meals (difference grades 3/4)	0.09	-	-	-
	(0.60)			
male teacher	2.01*	-	-	-
	(1.13)			
double shift (grade 2)	1.37	-	-	-
	(1.76)			
double shift (difference grades 2/3)	-5.59	-	-	-
	(4.02)			
double shift (difference grades 3/4)	-5.57	-	-	-
	(3.44)			
student age	1.05**	-	-	-
	(0.42)			
student speaks French at home (grade 2)	-0.37	-	-	-
	(1.42)			
student speaks French at home (difference grades 3/4)	-0.32	-	-	-
	(0.96)			
languages-student (grade 2)	-0.04	-	-	-
	(0.83)			
languages-student (difference grades 3/4)	-0.05	-	-	-
	(0.59)			
teacher speaks local language (grade 2)	-3.23*	-	-	-
	(1.70)			
teacher speaks local language (difference grades 2/3)	-3.68*	-	-	-
	(2.11)			
teacher speaks local language (difference grades 3/4)	-8.97*	-	-	-
	(5.34)			
teacher speaks French at home (grade 2)	2.86*	-	-	-
	(1.72)			
teacher speaks French at home (difference grades 2/3)	1.24	-	-	-
	(1.11)			
teacher speaks French at home (difference grades 3/4)	-0.82	-	-	-
	(1.07)			
study at home (grade 2)	0.73	-	-	-
	(1.06)			
study at home (difference grades 3/4)	-0.72	-	-	-
	(0.54)			
number of students	-0.01**	-	-	-
	(0.00)			
partnerships	-0.87	-	-	-
	(0.92)			
teacher meetings	0.60	-	-	-
	(0.60)			
constant	-34.79***	-	-	-
	(11.84)			

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. The estimation correctly classifies about 99% of non-repeaters and about 25% of repeaters. The estimation for the outcome after two years did not converge.

Table B3.3: Multi-level logit estimation of grade retention – Specification 3/Grade 5

Grade retention	One year	Two years	Three years	Four years
mean score of class (grade 2)	3.51***	-	-	-
	(1.36)			
mean score of class (difference grades 2/3)	2.58*	-	-	-
	(1.49)			
mean score of class (difference grades 3/4)	2.94**	-	-	-
	(1.38)			
Share repeaters in class (grade 2)	-3.77	-	-	-
	(6.01)			
prior repetition	-0.09	-	-	-
	(1.18)			
test score (grade 2)	-3.09***	-	-	-
	(0.79)			
test score (difference grades 2/3)	-2.67***	-	-	-
	(0.78)			
test score (difference grades 3/4)	-1.69***	-	-	-
	(0.58)			
test score (difference grades 4/5)	-0.54	-	-	-
	(0.39)			
boy	-1.06	-	-	-
	(1.42)			
property at home (grade 2)	-0.69*	-	-	-
	(0.39)			
property at home (difference grades 3/4)	-0.07	-	-	-
	(0.27)			
media availability (grade 2)	-0.72	-	-	-
	(0.82)			
media availability (difference grades 3/4)	-1.23	-	-	-
	(0.77)			
share math books (grade 2)	6.11*	-	-	-
	(3.27)			
share math books (difference grades 2/3)	3.94**	-	-	-
	(1.95)			
share math books (difference grades 3/4)	-6.04	-	-	-
	(4.69)			
share math books (difference grades 4/5)	-10.42**	-	-	-
	(5.11)			
city size (grade 2)	-0.57	-	-	-
	(0.83)			
teacher training (grade 2)	-0.16	-	-	-
	(0.65)			
teacher training (difference grades 2/3)	0.04	-	-	-
	(0.57)			
teacher training (difference grades 3/4)	-0.82	-	-	-
	(0.60)			
teacher training (difference grades 4/5)	-1.34**	-	-	-
	(0.56)			
work at home (grade 2)	-0.73	-	-	-
	(0.47)			

Table B3.3 Continued

Grade retention	One year	Two years	Three years	Four years
work at home (difference grades 3/4)	-0.55*	-	-	-
	(0.29)			
meals (grade 2)	-2.69	-	-	-
	(2.12)			
meals (difference grades 3/4)	-2.53**	-	-	-
	(1.13)			
male teacher	-1.52	-	-	-
	(1.33)			
double shift (grade 2)	-2.58	-	-	-
	(2.45)			
double shift (difference grades 2/3)	-3.70	-	-	-
	(2.79)			
double shift (difference grades 3/4)	-0.35	-	-	-
	(2.52)			
double shift (difference grades 4/5)	-6.66**	-	-	-
	(2.85)			
student age	0.28	-	-	-
	(0.50)			
student speaks French at home (grade 2)	-0.69	-	-	-
	(2.79)			
student speaks French at home (difference grades 3/4)	-3.36	-	-	-
	(2.36)			
languages-student (grade 2)	-4.08***	-	-	-
	(1.38)			
languages-student (difference grades 3/4)	-2.83**	-	-	-
	(1.35)			
study at home (grade 2)	-0.11	-	-	-
	(1.23)			
study at home (difference grades 3/4)	-0.22	-	-	-
	(0.81)			
number of students	0.01**	-	-	-
	(0.00)			
partnerships	0.87	-	-	-
	(0.65)			
teacher meetings	-1.69**	-	-	-
	(0.72)			
constant	12.81	-	-	-
	(11.02)			

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. The estimation correctly classifies about 97% of non-repeaters and about 71% of repeaters.

Appendix C: Balance after matching

Table C1.1.1: Balance of variables after matching – Specification 1/Grade 2/One year

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.27	-1.24	-0.03	0.78
share repeaters in class (grade 2)	0.15	0.15	0.01	0.68
class size	57.48	56.17	1.31	0.47
teacher job experience	14.29	14.07	0.22	0.84
prior repetition	0.18	0.21	-0.03	0.57
test score	-2.43	-2.35	-0.08	0.64
boy	0.39	0.46	-0.08	0.27
property at home	3.34	3.43	-0.09	0.75
media availability	1.43	1.41	0.02	0.85
share math books	0.32	0.32	-0.01	0.88
city size	3.43	3.42	0.02	0.91
teacher training	3.71	3.70	0.01	0.97
work at home	2.91	2.62	0.29	0.26
meals	2.94	2.96	-0.02	0.59
male teacher	0.56	0.59	-0.03	0.61
double shift	0.29	0.33	-0.04	0.51
student age	8.16	8.15	0.01	0.92
student speaks French at home	0.02	0.03	-0.01	0.65
languages-student	1.22	1.18	0.03	0.60
teacher speaks local language	0.61	0.61	0.00	0.98
teacher speaks French at home	2.67	2.69	-0.02	0.84
study at home	1.89	1.82	0.07	0.28
number of students	748.63	745.10	3.53	0.94
partnerships	0.66	0.56	0.10	0.35
teacher meetings	2.62	2.60	0.03	0.83

Table C1.1.2: Balance of variables after matching – Specification 1/Grade 3/One year

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.22	-1.21	-0.01	0.93
share repeaters in class (grade 2)	0.18	0.18	0.00	0.89
class size	50.08	49.89	0.19	0.90
teacher job experience	13.15	13.30	-0.15	0.88
prior repetition	0.40	0.41	0.00	0.95
test score	-1.20	-1.13	-0.07	0.68
boy	0.54	0.58	-0.04	0.59
property at home	3.12	3.10	0.02	0.95
media availability	1.43	1.39	0.04	0.74
share math books	0.39	0.39	0.00	0.98
city size	3.13	3.12	0.01	0.97
teacher training	3.89	3.83	0.07	0.67
work at home	2.56	2.43	0.13	0.57
meals	2.95	2.91	0.03	0.38
male teacher	0.63	0.60	0.03	0.66
double shift	0.28	0.30	-0.02	0.71
student age	9.42	9.48	-0.06	0.61
student speaks French at home	0.00	0.00	0.00	0.52
languages-student	1.23	1.25	-0.02	0.79
teacher speaks local language	0.87	0.85	0.01	0.75
teacher speaks French at home	2.46	2.56	-0.09	0.42
study at home	1.78	1.76	0.02	0.83
number of students	650.10	672.76	-22.66	0.57
partnerships	0.57	0.57	0.00	0.96
teacher meetings	2.71	2.65	0.06	0.58

Table C1.1.3: Balance of variables after matching – Specification 1/Grade 4/One year

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 3)	-0.20	-0.20	0.00	0.98
share repeaters in class (grade 2)	0.13	0.13	0.00	0.87
class size	53.13	52.36	0.77	0.78
teacher job experience	13.98	14.41	-0.44	0.81
prior repetition	0.28	0.28	0.00	0.97
test score	0.77	0.82	-0.05	0.86
boy	0.53	0.54	-0.01	0.93
property at home	3.55	3.70	-0.14	0.75
media availability	1.77	1.81	-0.04	0.84
share math books	0.48	0.48	-0.01	0.92
city size	3.43	3.43	0.00	1.00
teacher training	3.43	3.43	0.00	0.99
work at home	3.36	3.37	0.00	0.99
meals	1.89	1.88	0.02	0.83
male teacher	0.66	0.66	0.00	0.97
double shift	0.21	0.22	0.00	0.97
student age	10.40	10.40	0.01	0.97
student speaks French at home	0.09	0.09	0.00	1.00
languages-student	1.06	1.07	0.00	0.99
teacher speaks local language	0.77	0.78	-0.02	0.85
teacher speaks French at home	2.62	2.61	0.00	0.98
study at home	1.64	1.63	0.01	0.94
number of students	794.51	795.73	-1.22	0.98
partnerships	0.51	0.47	0.04	0.78
teacher meetings	2.55	2.52	0.03	0.89

Table C1.1.4: Balance of variables after matching – Specification 1/Grade 5/One year

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 4)	1.03	1.05	-0.02	0.89
share repeaters in class (grade 2)	0.16	0.13	0.02	0.29
prior repetition	0.34	0.28	0.06	0.56
test score	1.19	0.75	0.44	0.22
boy	0.50	0.62	-0.12	0.27
property at home	3.66	3.23	0.43	0.39
media availability	1.59	1.68	-0.09	0.65
share math books	0.46	0.40	0.06	0.46
city size	2.95	2.96	0.00	1.00
teacher training	3.68	3.60	0.08	0.73
work at home	3.98	3.32	0.65	0.19
meals	1.82	1.82	0.00	0.99
male teacher	0.80	0.81	-0.02	0.85
double shift	0.09	0.06	0.03	0.56
student age	11.18	11.30	-0.12	0.49
student speaks French at home	0.09	0.05	0.04	0.50
languages-student	0.95	1.02	-0.06	0.54
study at home	1.61	1.52	0.10	0.50
number of students	699.66	637.60	62.06	0.42
partnerships	0.43	0.41	0.03	0.84
teacher meetings	2.52	2.70	-0.18	0.42

Table C1.2.1: Balance of variables after matching – Specification 1/Grade 2/Two years

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.27	-1.29	0.02	0.85
share repeaters in class (grade 2)	0.16	0.16	0.00	0.96
class size	56.45	55.62	0.83	0.69
teacher job experience	15.67	14.57	1.10	0.42
prior repetition	0.13	0.11	0.02	0.69
test score	-2.33	-2.27	-0.06	0.80
boy	0.36	0.45	-0.08	0.32
property at home	3.45	3.43	0.02	0.96
media availability	1.48	1.47	0.01	0.94
share math books	0.32	0.34	-0.02	0.63
city size	3.42	3.37	0.05	0.76
teacher training	3.59	3.49	0.11	0.60
work at home	2.97	2.75	0.22	0.51
meals	2.93	2.96	-0.03	0.46
male teacher	0.59	0.64	-0.04	0.61
double shift	0.30	0.34	-0.03	0.68
student age	8.13	8.06	0.07	0.57
student speaks French at home	0.01	0.02	-0.01	0.76
languages-student	1.20	1.20	0.00	1.00
teacher speaks local language	0.65	0.64	0.01	0.88
teacher speaks French at home	2.68	2.65	0.03	0.82
study at home	1.88	1.86	0.03	0.73
number of students	762.32	722.30	40.02	0.45
partnerships	0.57	0.49	0.07	0.57
teacher meetings	2.52	2.56	-0.04	0.79

Table C1.2.2: Balance of variables after matching – Specification 1/Grade 3/Two years

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.21	-1.18	-0.03	0.71
share repeaters in class (grade 2)	0.18	0.18	0.00	0.81
class size	51.00	51.62	-0.62	0.76
teacher job experience	12.73	13.08	-0.36	0.76
prior repetition	0.38	0.36	0.02	0.79
test score	-1.11	-0.97	-0.14	0.53
boy	0.52	0.54	-0.03	0.76
property at home	2.95	3.14	-0.19	0.63
media availability	1.39	1.45	-0.06	0.70
share math books	0.39	0.38	0.00	0.96
city size	3.05	3.12	-0.06	0.73
teacher training	3.92	3.85	0.07	0.70
work at home	2.60	2.40	0.20	0.48
meals	2.95	2.94	0.02	0.61
male teacher	0.65	0.65	0.00	0.97
double shift	0.27	0.29	-0.01	0.85
student age	9.34	9.35	-0.02	0.91
student speaks French at home	0.00	0.01	-0.01	0.53
languages-student	1.19	1.18	0.01	0.91
teacher speaks local language	0.88	0.89	0.00	0.95
teacher speaks French at home	2.43	2.47	-0.04	0.76
study at home	1.73	1.72	0.01	0.95
number of students	619.53	654.59	-35.06	0.46
partnerships	0.49	0.50	-0.01	0.95
teacher meetings	2.66	2.64	0.02	0.88

Table C1.2.3: Balance of variables after matching – Specification 1/Grade 4/Two years

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 3)	-0.13	-0.14	0.01	0.93
share repeaters in class (grade 2)	0.10	0.11	-0.01	0.62
class size	49.62	49.70	-0.08	0.98
teacher job experience	14.62	14.36	0.25	0.92
prior repetition	0.27	0.27	0.00	0.99
test score	0.74	0.81	-0.07	0.86
boy	0.54	0.55	-0.01	0.93
property at home	3.58	3.66	-0.08	0.90
media availability	1.81	1.78	0.03	0.92
share math books	0.48	0.48	0.00	0.97
city size	3.54	3.43	0.10	0.68
teacher training	3.38	3.36	0.03	0.95
work at home	3.15	3.31	-0.15	0.79
meals	1.85	1.84	0.00	0.98
male teacher	0.65	0.66	-0.01	0.97
double shift	0.19	0.22	-0.02	0.84
student age	10.23	10.19	0.04	0.85
student speaks French at home	0.12	0.10	0.02	0.86
languages-student	0.96	0.95	0.01	0.93
teacher speaks local language	0.81	0.79	0.02	0.89
teacher speaks French at home	2.81	2.75	0.06	0.81
study at home	1.58	1.62	-0.04	0.83
number of students	788.81	785.63	3.18	0.97
partnerships	0.50	0.50	0.00	0.98
teacher meetings	2.50	2.51	-0.01	0.98

Table C1.3.1: Balance of variables after matching – Specification 1/Grade 2/Three years

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.32	-1.32	0.00	0.98
share repeaters in class (grade 2)	0.15	0.15	0.00	0.95
class size	56.07	55.97	0.10	0.97
teacher job experience	15.23	14.74	0.49	0.74
prior repetition	0.11	0.14	-0.02	0.70
test score	-2.38	-2.23	-0.15	0.59
boy	0.39	0.46	-0.07	0.43
property at home	3.21	3.44	-0.23	0.56
media availability	1.48	1.47	0.00	1.00
share math books	0.31	0.32	-0.01	0.90
city size	3.36	3.30	0.06	0.74
teacher training	3.64	3.57	0.07	0.75
work at home	3.07	2.68	0.39	0.26
meals	2.92	2.94	-0.02	0.63
male teacher	0.61	0.63	-0.02	0.82
double shift	0.33	0.35	-0.02	0.78
student age	8.13	8.08	0.05	0.75
student speaks French at home	0.03	0.06	-0.03	0.49
languages-student	1.23	1.22	0.01	0.87
teacher speaks local language	0.59	0.60	-0.01	0.93
teacher speaks French at home	2.62	2.61	0.01	0.96
study at home	1.85	1.83	0.02	0.82
number of students	761.26	735.93	25.33	0.68
partnerships	0.69	0.57	0.12	0.41
teacher meetings	2.59	2.60	-0.01	0.96

Table C1.3.2: Balance of variables after matching – Specification 1/Grade 3/Three years

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.23	-1.17	-0.06	0.57
share repeaters in class (grade 2)	0.18	0.18	0.00	1.00
class size	51.22	52.03	-0.80	0.73
teacher job experience	13.09	14.13	-1.04	0.47
prior repetition	0.41	0.41	0.00	0.99
test score	-1.07	-0.96	-0.12	0.65
boy	0.52	0.50	0.02	0.86
property at home	2.81	2.90	-0.09	0.85
media availability	1.43	1.48	-0.05	0.78
share math books	0.35	0.39	-0.05	0.49
city size	3.07	3.19	-0.12	0.58
teacher training	3.97	3.75	0.22	0.33
work at home	2.28	2.26	0.01	0.97
meals	2.97	2.96	0.01	0.82
male teacher	0.76	0.73	0.03	0.72
double shift	0.26	0.28	-0.02	0.83
student age	9.43	9.42	0.01	0.96
student speaks French at home	0.00	0.00	0.00	0.66
languages-student	1.21	1.33	-0.12	0.26
teacher speaks local language	0.91	0.91	0.01	0.90
teacher speaks French at home	2.45	2.59	-0.14	0.41
study at home	1.71	1.77	-0.06	0.59
number of students	597.40	634.32	-36.92	0.49
partnerships	0.50	0.49	0.01	0.91
teacher meetings	2.62	2.63	-0.01	0.95

Table C1.4: Balance of variables after matching – Specification 1/Grade 2/Four years

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.35	-1.37	0.02	0.90
share repeaters in class (grade 2)	0.15	0.15	0.00	0.93
class size	54.74	54.71	0.03	0.99
teacher job experience	14.15	14.84	-0.69	0.66
prior repetition	0.15	0.14	0.01	0.86
test score	-2.42	-2.34	-0.08	0.77
boy	0.40	0.46	-0.06	0.51
property at home	3.15	3.48	-0.32	0.44
media availability	1.45	1.57	-0.11	0.50
share math books	0.29	0.32	-0.03	0.52
city size	3.40	3.33	0.07	0.73
teacher training	3.74	3.71	0.03	0.88
work at home	2.96	2.70	0.26	0.47
meals	2.92	2.93	-0.02	0.78
male teacher	0.62	0.61	0.01	0.91
double shift	0.30	0.34	-0.04	0.66
student age	8.13	8.05	0.09	0.57
student speaks French at home	0.00	0.01	-0.01	0.52
languages-student	1.21	1.19	0.01	0.87
teacher speaks local language	0.66	0.69	-0.03	0.78
teacher speaks French at home	2.70	2.58	0.12	0.50
study at home	1.89	1.87	0.02	0.83
number of students	712.23	734.37	-22.14	0.73
partnerships	0.83	0.64	0.19	0.26
teacher meetings	2.60	2.64	-0.03	0.83

Table C2.1.1: Balance of variables after matching – Specification 2/Grade 3/One year

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.20	-1.16	-0.04	0.60
share repeaters in class (grade 2)	0.18	0.18	0.00	0.93
class size	50.01	50.19	-0.18	0.92
teacher job experience	13.13	14.10	-0.97	0.34
prior repetition	0.39	0.40	-0.02	0.81
test score (grade 2)	-1.73	-1.64	-0.09	0.59
test score (difference grades 2/3)	0.60	0.55	0.05	0.70
boy	0.50	0.53	-0.03	0.68
property at home	3.25	3.39	-0.15	0.67
media availability	1.49	1.50	-0.01	0.92
share math books	0.40	0.39	0.01	0.91
city size	3.18	3.21	-0.03	0.84
teacher training	3.92	3.84	0.08	0.63
work at home	2.60	2.41	0.19	0.45
meals	2.95	2.94	0.01	0.73
male teacher	0.61	0.62	-0.01	0.94
double shift	0.26	0.28	-0.02	0.74
student age	9.39	9.43	-0.04	0.74
student speaks French at home	0.00	0.00	0.00	0.62
languages-student	1.23	1.22	0.01	0.88
teacher speaks local language	0.88	0.89	-0.01	0.87
teacher speaks French at home	2.52	2.55	-0.03	0.81
study at home	1.80	1.79	0.01	0.88
number of students	657.67	680.58	-22.91	0.59
partnerships	0.58	0.53	0.06	0.58
teacher meetings	2.70	2.62	0.08	0.47

Table C2.1.2: Balance of variables after matching – Specification 2/Grade 4/One year

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 3)	-0.25	-0.25	0.00	0.98
share repeaters in class (grade 2)	0.12	0.13	-0.01	0.68
class size	54.03	52.83	1.20	0.73
teacher job experience	13.27	13.54	-0.28	0.90
prior repetition	0.26	0.28	-0.01	0.89
test score (grade 2)	-1.27	-1.26	-0.01	0.97
test score (difference grades 2/3)	0.65	0.69	-0.04	0.85
test score (difference grades 3/4)	1.41	1.34	0.07	0.83
boy	0.50	0.51	-0.01	0.94
property at home	3.79	3.82	-0.02	0.97
media availability	1.82	1.86	-0.03	0.89
share math books	0.52	0.51	0.00	0.97
city size	3.41	3.36	0.05	0.83
teacher training	3.53	3.45	0.07	0.82
work at home	3.59	3.67	-0.08	0.88
meals	1.90	1.87	0.03	0.75
male teacher	0.65	0.65	0.00	1.00
double shift	0.18	0.17	0.00	0.98
student age	10.38	10.37	0.01	0.94
student speaks French at home	0.12	0.12	0.00	0.97
languages-student	1.12	1.12	0.00	0.99
teacher speaks local language	0.76	0.77	-0.01	0.92
teacher speaks French at home	2.74	2.67	0.07	0.74
study at home	1.56	1.55	0.01	0.95
number of students	783.79	760.50	23.29	0.72
partnerships	0.56	0.58	-0.02	0.91
teacher meetings	2.71	2.60	0.11	0.65

Table C2.1.3: Balance of variables after matching – Specification 2/Grade 5/One year

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 4)	1.05	1.14	-0.09	0.55
share repeaters in class (grade 2)	0.15	0.13	0.02	0.37
prior repetition	0.31	0.27	0.04	0.66
test score (grade 2)	-1.24	-1.23	0.00	0.99
test score (difference grades 2/3)	0.52	0.69	-0.17	0.47
test score (difference grades 3/4)	1.33	1.16	0.17	0.55
test score (difference grades 4/5)	0.57	0.41	0.16	0.67
boy	0.50	0.58	-0.08	0.48
property at home	3.40	3.53	-0.13	0.81
media availability	1.57	1.81	-0.24	0.21
share math books	0.42	0.47	-0.05	0.57
city size	2.83	2.89	-0.06	0.83
teacher training	3.79	3.62	0.17	0.48
work at home	3.90	3.01	0.89	0.08
meals	1.88	1.81	0.08	0.48
male teacher	0.86	0.77	0.09	0.30
double shift	0.07	0.09	-0.02	0.74
student age	11.14	11.28	-0.13	0.40
student speaks French at home	0.14	0.09	0.06	0.43
languages-student	0.98	1.01	-0.04	0.71
study at home	1.57	1.47	0.10	0.51
number of students	676.48	653.13	23.35	0.77
partnerships	0.55	0.37	0.17	0.24
teacher meetings	2.62	2.85	-0.23	0.23

Table C2.2.1: Balance of variables after matching – Specification 2/Grade 3/Two years

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.19	-1.13	-0.06	0.50
share repeaters in class (grade 2)	0.17	0.17	0.00	0.94
class size	51.65	51.55	0.10	0.96
teacher job experience	12.93	13.31	-0.38	0.75
prior repetition	0.38	0.38	0.00	1.00
test score (grade 2)	-1.63	-1.49	-0.14	0.45
test score (difference grades 2/3)	0.54	0.52	0.02	0.91
boy	0.51	0.51	0.00	1.00
property at home	3.04	3.52	-0.47	0.26
media availability	1.44	1.55	-0.11	0.46
share math books	0.39	0.43	-0.04	0.55
city size	3.08	3.19	-0.11	0.57
teacher training	3.93	3.90	0.03	0.88
work at home	2.55	2.48	0.07	0.80
meals	2.96	2.95	0.01	0.77
male teacher	0.63	0.61	0.03	0.75
double shift	0.24	0.24	0.00	0.99
student age	9.31	9.29	0.02	0.87
student speaks French at home	0.00	0.00	0.00	0.59
languages-student	1.21	1.22	-0.01	0.89
teacher speaks local language	0.89	0.90	-0.01	0.80
teacher speaks French at home	2.45	2.48	-0.03	0.85
study at home	1.80	1.78	0.02	0.82
number of students	632.52	652.15	-19.63	0.69
partnerships	0.51	0.49	0.02	0.87
teacher meetings	2.63	2.57	0.06	0.65

Table C2.2.2: Balance of variables after matching – Specification 2/Grade 4/Two years

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 3)	-0.17	-0.25	0.08	0.67
share repeaters in class (grade 2)	0.10	0.11	-0.01	0.64
class size	51.16	50.11	1.05	0.74
teacher job experience	13.79	13.87	-0.08	0.98
prior repetition	0.32	0.27	0.05	0.77
test score (grade 2)	-1.27	-1.27	0.00	0.99
test score (difference grades 2/3)	0.56	0.37	0.19	0.51
test score (difference grades 3/4)	1.41	1.60	-0.20	0.67
boy	0.53	0.57	-0.04	0.81
property at home	3.58	3.95	-0.37	0.63
media availability	1.68	1.91	-0.23	0.47
share math books	0.49	0.53	-0.04	0.66
city size	3.42	3.48	-0.06	0.85
teacher training	3.42	3.45	-0.03	0.95
work at home	3.37	3.95	-0.59	0.43
meals	1.87	1.71	0.16	0.35
male teacher	0.68	0.69	-0.01	0.97
double shift	0.21	0.26	-0.05	0.75
student age	10.16	10.19	-0.03	0.91
student speaks French at home	0.16	0.09	0.07	0.53
languages-student	0.95	0.91	0.04	0.78
teacher speaks local language	0.68	0.80	-0.12	0.42
teacher speaks French at home	2.95	2.93	0.02	0.93
study at home	1.47	1.41	0.06	0.80
number of students	772.58	784.45	-11.87	0.89
partnerships	0.58	0.54	0.04	0.88
teacher meetings	2.74	2.58	0.15	0.61

Table C2.3: Balance of variables after matching – Specification 2/Grade 3/Three years

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.22	-1.20	-0.02	0.85
share repeaters in class (grade 2)	0.18	0.17	0.01	0.78
class size	51.18	49.90	1.28	0.58
teacher job experience	13.13	13.52	-0.39	0.78
prior repetition	0.39	0.37	0.03	0.76
test score (grade 2)	-1.66	-1.67	0.01	0.97
test score (difference grades 2/3)	0.62	0.56	0.06	0.74
boy	0.52	0.54	-0.02	0.83
property at home	2.88	3.06	-0.18	0.71
media availability	1.46	1.46	0.00	0.98
share math books	0.35	0.40	-0.05	0.49
city size	3.11	3.09	0.02	0.94
teacher training	3.95	3.85	0.10	0.66
work at home	2.23	2.17	0.06	0.82
meals	2.96	2.96	0.01	0.89
male teacher	0.75	0.75	0.00	0.97
double shift	0.25	0.25	0.00	0.98
student age	9.38	9.35	0.02	0.89
student speaks French at home	0.00	0.00	0.00	0.78
languages-student	1.20	1.27	-0.07	0.49
teacher speaks local language	0.91	0.89	0.02	0.74
teacher speaks French at home	2.48	2.55	-0.07	0.68
study at home	1.73	1.75	-0.01	0.91
number of students	597.00	616.49	-19.49	0.72
partnerships	0.52	0.55	-0.03	0.82
teacher meetings	2.61	2.56	0.05	0.78

Table C3.1.1: Balance of variables after matching – Specification 3/Grade 3/One year

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.15	-1.11	-0.04	0.67
share repeaters in class (grade 2)	0.16	0.17	0.00	0.80
class size (grade 2)	56.84	55.99	0.85	0.70
class size (difference grades 2/3)	-7.48	-6.81	-0.67	0.74
teacher job experience (grade 2)	15.19	15.85	-0.65	0.60
teacher job experience (grades 2/3)	-1.65	-1.67	0.02	0.99
prior repetition	0.40	0.44	-0.04	0.57
test score (grade 2)	-1.61	-1.56	-0.05	0.77
test score (difference grades 2/3)	0.56	0.56	0.00	0.98
boy	0.52	0.49	0.03	0.70
property at home (grade 2)	3.70	3.82	-0.12	0.74
media availability (grade 2)	1.54	1.54	0.00	0.99
share math books (grade 2)	0.38	0.37	0.01	0.83
share math books (difference grades 2/3)	0.03	0.04	0.00	0.92
city size (grade 2)	3.35	3.38	-0.03	0.84
teacher training (grade 2)	3.58	3.50	0.07	0.69
teacher training (difference grades 2/3)	0.23	0.33	-0.10	0.72
work at home (grade 2)	2.66	2.64	0.02	0.93
meals (grade 2)	2.94	2.93	0.01	0.87
male teacher (grade 2)	0.61	0.61	0.00	0.96
male teacher (difference grades 2/3)	-0.02	-0.04	0.02	0.83
double shift (grade 2)	0.25	0.26	-0.01	0.91
double shift (difference grades 2/3)	0.01	0.01	0.00	0.92
student age	9.34	9.42	-0.08	0.59
teacher speaks French at home (grade 2)	0.00	0.00	0.00	0.77
languages-student (grade 2)	1.28	1.29	-0.01	0.90
teacher speaks French at home (grade 2)	0.65	0.68	-0.03	0.73
teacher speaks local language (difference grades 2/3)	0.22	0.21	0.01	0.91
teacher speaks French at home (grade 2)	2.65	2.61	0.04	0.72
teacher speaks French at home (difference grades 2/3)	-0.12	-0.03	-0.09	0.60
study at home (grade 2)	1.84	1.85	0.00	0.97
number of students	689.17	693.85	-4.68	0.92
partnerships	0.59	0.53	0.06	0.59
teacher meetings	2.67	2.60	0.08	0.58

Table C3.1.2: Balance of variables after matching – Specification 3/Grade 4/One year

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.36	-1.35	-0.01	0.97
mean score of class (difference grades 2/3)	1.14	1.11	0.03	0.85
share repeaters in class (grade 2)	0.12	0.12	-0.01	0.79
class size (grade 2)	56.13	56.49	-0.36	0.92
class size (difference grades 2/3)	-3.96	-6.25	2.29	0.66
class size (difference grades 3/4)	0.58	1.41	-0.83	0.87
teacher job experience (grade 2)	15.79	15.09	0.70	0.80
teacher job experience (grades 2/3)	0.08	-0.88	0.96	0.70
teacher job experience (grades 3/4)	-2.42	-1.81	-0.61	0.78
prior repetition	0.21	0.20	0.01	0.96
test score (grade 2)	-1.24	-1.31	0.07	0.82
test score (difference grades 2/3)	0.78	0.84	-0.06	0.78
test score (difference grades 3/4)	1.27	1.15	0.11	0.78
boy	0.50	0.45	0.05	0.71
property at home (grade 2)	3.96	3.76	0.20	0.76
property at home (difference grades 3/4)	0.13	0.25	-0.12	0.84
media availability (grade 2)	1.67	1.70	-0.03	0.91
media availability (difference grades 3/4)	0.17	0.25	-0.08	0.77
share math books (grade 2)	0.29	0.31	-0.02	0.73
share math books (difference grades 2/3)	0.04	0.07	-0.02	0.66
share math books (difference grades 3/4)	0.19	0.17	0.02	0.76
city size (grade 2)	3.46	3.31	0.15	0.58
teacher training (grade 2)	3.58	3.78	-0.19	0.60
teacher training (difference grades 2/3)	0.00	-0.27	0.27	0.56
teacher training (difference grades 3/4)	0.04	0.20	-0.16	0.71
work at home (grade 2)	3.00	3.12	-0.12	0.84
work at home (difference grades 3/4)	0.33	0.46	-0.13	0.85
meals (grade 2)	2.94	2.96	-0.02	0.73
meals (difference grades 3/4)	-1.08	-1.03	-0.05	0.68
male teacher	0.63	0.64	-0.02	0.90
double shift (grade 2)	0.29	0.30	-0.01	0.95
double shift (difference grades 2/3)	-0.13	-0.09	-0.03	0.72
double shift (difference grades 3/4)	-0.08	-0.07	-0.02	0.84
student age	10.42	10.35	0.07	0.78
teacher speaks French at home (grade 2)	0.08	0.06	0.02	0.81
teacher speaks French at home (difference grades 3/4)	0.04	0.01	0.03	0.81
languages-student (grade 2)	1.17	1.19	-0.02	0.87
languages-student (difference grades 3/4)	-0.04	-0.13	0.09	0.57
teacher speaks French at home (grade 2)	0.63	0.63	0.00	0.99
teacher speaks local language (difference grades 2/3)	0.25	0.26	-0.01	0.96
teacher speaks local language (difference grades 3/4)	-0.08	-0.11	0.02	0.80
teacher speaks French at home (grade 2)	2.75	2.72	0.03	0.88
teacher speaks French at home (difference grades 2/3)	-0.21	-0.31	0.10	0.78
teacher speaks French at home (difference grades 3/4)	0.21	0.32	-0.11	0.73
study at home (grade 2)	1.92	1.94	-0.02	0.85
study at home (difference grades 3/4)	-0.29	-0.30	0.00	0.98
number of students	804.96	779.72	25.24	0.73
partnerships	0.58	0.60	-0.02	0.93
teacher meetings	2.67	2.58	0.09	0.75

Table C3.1.3: Balance of variables after matching – Specification 3/Grade 5/One year

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.38	-1.60	0.22	0.51
mean score of class (difference grades 2/3)	1.24	1.45	-0.21	0.21
mean score of class (difference grades 3/4)	1.14	1.22	-0.07	0.63
share repeaters in class (grade 2)	0.16	0.12	0.04	0.30
prior repetition	0.21	0.19	0.02	0.88
test score (grade 2)	-1.29	-1.52	0.23	0.59
test score (difference grades 2/3)	0.89	1.28	-0.39	0.33
test score (difference grades 3/4)	1.02	1.00	0.02	0.97
test score (difference grades 4/5)	0.74	0.42	0.32	0.57
boy	0.57	0.52	0.05	0.81
property at home (grade 2)	3.93	2.92	1.01	0.22
property at home (difference grades 3/4)	0.43	0.53	-0.11	0.87
media availability (grade 2)	1.64	1.42	0.23	0.45
media availability (difference grades 3/4)	0.36	0.32	0.04	0.90
share math books (grade 2)	0.36	0.27	0.09	0.35
share math books (difference grades 2/3)	0.12	0.15	-0.03	0.76
share math books (difference grades 3/4)	0.10	0.12	-0.02	0.76
share math books (difference grades 4/5)	-0.08	-0.10	0.02	0.79
city size (grade 2)	3.64	3.19	0.46	0.17
teacher training (grade 2)	3.71	3.68	0.03	0.94
teacher training (difference grades 2/3)	0.00	-0.37	0.37	0.49
teacher training (difference grades 3/4)	-0.14	0.33	-0.47	0.24
teacher training (difference grades 4/5)	0.07	0.02	0.05	0.94
work at home (grade 2)	1.79	2.18	-0.39	0.58
work at home (difference grades 3/4)	1.64	1.77	-0.13	0.87
meals (grade 2)	2.96	2.99	-0.02	0.64
meals (difference grades 3/4)	-0.93	-0.96	0.03	0.70
male teacher	0.79	0.83	-0.05	0.76
double shift (grade 2)	0.29	0.26	0.02	0.90
double shift (difference grades 2/3)	0.00	0.00	0.00	0.93
double shift (difference grades 3/4)	-0.07	-0.02	-0.05	0.57
double shift (difference grades 4/5)	-0.14	-0.09	-0.05	0.69
student age	11.00	10.86	0.14	0.60
teacher speaks French at home (grade 2)	0.14	0.32	-0.18	0.29
teacher speaks French at home (difference grades 3/4)	-0.07	-0.27	0.20	0.32
languages-student (grade 2)	1.14	1.13	0.01	0.96
languages-student (difference grades 3/4)	-0.14	-0.12	-0.02	0.92
study at home (grade 2)	1.93	1.94	-0.02	0.89
study at home (difference grades 3/4)	-0.21	-0.14	-0.08	0.75
number of students	872.64	773.02	99.62	0.50
Partnerships	0.50	0.28	0.22	0.44
teacher meetings	2.79	2.46	0.32	0.36

Table C3.2: Balance of variables after matching – Specification 3/Grade 3/Two years

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.14	-1.10	-0.04	0.72
share repeaters in class (grade 2)	0.16	0.16	-0.01	0.74
class size (grade 2)	56.38	56.35	0.03	0.99
class size (difference grades 2/3)	-5.78	-6.54	0.77	0.72
teacher job experience (grade 2)	15.48	15.27	0.21	0.89
teacher job experience (grades 2/3)	-2.12	-1.69	-0.43	0.79
prior repetition	0.36	0.35	0.01	0.91
test score (grade 2)	-1.57	-1.46	-0.10	0.62
test score (difference grades 2/3)	0.51	0.54	-0.03	0.89
boy	0.50	0.50	0.00	1.00
property at home (grade 2)	3.50	3.48	0.02	0.96
media availability (grade 2)	1.48	1.47	0.01	0.94
share math books (grade 2)	0.36	0.36	0.00	0.94
share math books (difference grades 2/3)	0.03	0.03	0.01	0.88
city size (grade 2)	3.31	3.36	-0.05	0.79
teacher training (grade 2)	3.53	3.55	-0.01	0.96
teacher training (difference grades 2/3)	0.31	0.20	0.11	0.73
work at home (grade 2)	2.67	2.65	0.02	0.94
meals (grade 2)	2.96	2.93	0.02	0.57
male teacher (grade 2)	0.67	0.64	0.04	0.68
male teacher (difference grades 2/3)	-0.09	-0.07	-0.01	0.88
double shift (grade 2)	0.24	0.28	-0.04	0.63
double shift (difference grades 2/3)	0.03	0.04	0.00	0.91
student age	9.22	9.25	-0.03	0.87
teacher speaks French at home (grade 2)	0.00	0.00	0.00	0.71
languages-student (grade 2)	1.26	1.27	-0.01	0.90
teacher speaks French at home (grade 2)	0.67	0.65	0.02	0.79
teacher speaks local language (difference grades 2/3)	0.19	0.20	-0.01	0.87
teacher speaks French at home (grade 2)	2.60	2.63	-0.02	0.88
teacher speaks French at home (difference grades 2/3)	-0.16	-0.12	-0.03	0.87
study at home (grade 2)	1.83	1.80	0.03	0.77
number of students	663.53	697.61	-34.08	0.51
partnerships	0.53	0.56	-0.03	0.83
teacher meetings	2.62	2.64	-0.02	0.91

Table C3.3: Balance of variables after matching – Specification 3/Grade 3/Three years

	Mean			
variable	Treated	Control	Difference	p-value
mean score of class (grade 2)	-1.16	-1.13	-0.04	0.77
share repeaters in class (grade 2)	0.16	0.17	-0.01	0.63
class size (grade 2)	55.91	56.86	-0.95	0.74
class size (difference grades 2/3)	-5.95	-6.64	0.69	0.80
teacher job experience (grade 2)	16.00	15.94	0.06	0.97
teacher job experience (grades 2/3)	-2.19	-1.69	-0.49	0.79
prior repetition	0.37	0.34	0.04	0.73
test score (grade 2)	-1.55	-1.54	-0.01	0.97
test score (difference grades 2/3)	0.62	0.50	0.12	0.59
boy	0.53	0.60	-0.06	0.56
property at home (grade 2)	3.49	3.46	0.03	0.95
media availability (grade 2)	1.56	1.57	-0.01	0.94
share math books (grade 2)	0.35	0.40	-0.06	0.40
share math books (difference grades 2/3)	0.02	0.04	-0.02	0.70
city size (grade 2)	3.42	3.33	0.09	0.68
teacher training (grade 2)	3.47	3.62	-0.15	0.52
teacher training (difference grades 2/3)	0.37	0.15	0.22	0.51
work at home (grade 2)	2.26	2.11	0.14	0.66
meals (grade 2)	2.95	2.96	0.00	0.92
male teacher (grade 2)	0.70	0.71	-0.01	0.90
male teacher (difference grades 2/3)	0.00	-0.03	0.03	0.76
double shift (grade 2)	0.23	0.25	-0.01	0.89
double shift (difference grades 2/3)	0.05	0.06	-0.01	0.85
student age	9.28	9.19	0.09	0.65
teacher speaks French at home (grade 2)	0.00	0.00	0.00	0.72
languages-student (grade 2)	1.26	1.28	-0.02	0.85
teacher speaks French at home (grade 2)	0.67	0.68	-0.01	0.94
teacher speaks local language (difference grades 2/3)	0.21	0.13	0.08	0.46
teacher speaks French at home (grade 2)	2.53	2.50	0.04	0.82
teacher speaks French at home (difference grades 2/3)	0.00	-0.03	0.03	0.89
study at home (grade 2)	1.77	1.78	-0.01	0.93
number of students	637.42	674.99	-37.57	0.52
partnerships	0.58	0.59	0.00	0.98
teacher meetings	2.60	2.60	0.00	1.00

Appendix D: Data management – editing and imputations

Editing and imputations of the data were necessary because:

1. There are inconsistencies in the data (contradictions).
2. Some questions changed from one questionnaire to the next (or were not included at all).
3. Students and directors were not questioned in every wave.

The explanations below detail how we proceeded in the construction of the variables from the raw data to the final data set.

Repetition

The survey period includes the school years from 1995/1996 (wave 1) to 1999/2000 (wave5). There were inconsistencies and missing values in the variable repetition. As there was no information on this in the year 96/97, repetition was assigned the value 0 if the student attended the third grade in that school year. Since there was no student questionnaire in the school year 1998/99, the respective values have been imputed using the grades students were attending in the school years before and after 98/99. For inconsistencies, repetition has been assigned the value one if students are in the same grade as in the year before. It has been assigned the value zero if they have proceeded by one grade or if it is a missing value although the students have not dropped out and if they are not in the same grade as in the year before. When students have dropped out, they are assigned a missing value for repetition.

Property at home

The components of property at home are from the students questionnaires in 95/96 and 97/98. The students were not asked the respective questions in the other waves of the panel. I have assigned the values of the first wave of the panel to the second wave. Similarly, I have assigned the values of the third wave of the panel to the fourth and fifth wave. If the third wave information was missing I have used the information of the first wave for all succeeding waves and if the first wave information was missing I have used the third wave information for all remaining waves.

City size

The components of city size are from the director's questionnaire in 95/96. As the school location is fixed, I have assigned the respective values to the following years according to the information of the school year 95/96.

Class size

Information on class size was only asked in the first three waves of the panel 95/96, 96/97 and 97/98. Class size reflects the number of students who are effectively present on average. This should include the total number of students when there is a double shift. However, sometimes, in cases of double shift classes, the class size is much smaller and so it is assumed that this division has already taken place. I use half of this effective number if instruction takes place in double shifts and if the sum of the indicated number of boys and girls is less than two thirds of the effective number of students. As it is not possible to plausibly assign values for class size in the last two waves I have refrained from doing so. However, when there were missing values for a student in the final panel data set and there was information for the same class by another student, I have replaced the missing value accordingly.

Teacher training

Since students who are in the same class have the same teacher and therefore are faced with the same teacher characteristics, missing values for students have been assigned the value of other students with non-missing values who attend the same class.

Mean score of class

This variable is constructed from all the students of each grade per school. This means that it also includes the scores of repeaters of later waves, which is necessary to avoid considering the scores of non-repeating students only. For grade 2, only the first wave has been considered since there were already repeaters in the initial sample.

Share math books

This variable was created from individual information of students regarding their possession of math books. Missing values for students in 96/97 who were in third grade were assigned their respective values of 95/96 if they were the same as their values indicated for 97/98. Missing values in 98/99 were assigned the values of 95/96 if these were equal to their values

in 97/98. For the remaining missing values I have calculated the share of math books from the non-missing values within a class and assigned this value to all students of the class.

Student age

A few students were indicated to be between zero and two years old in wave three. These observations were considered to be nonsensical and their age indicated in the first wave was used to calculate how old they were in each year. Students who had missing information on their age in the first wave of the panel were assigned the value 8, which is the modal value for the first wave. To make sure that no further data entry mistake could happen I have used the first wave's age and added one in every succeeding wave.

Boy

Missing information was filled based on the information given in the first wave as this variable does not change over time. In case of contradictions between first wave and third wave information I used the first wave information. In case of a missing value in the first wave, the value of the third wave was used if it was available.

Student speaks French at home

Analogous to property at home (see above).

Languages-student

Analogous to property at home (see above).

Teacher speaks French at home

Inconsistent responses (if teachers indicated they speak often and rarely French at home) have been set to missing values. Imputation using Stata's impute command using teachers' information on their gender, marital status, living status (alone, with family), knowledge of the local language, professional status, diplomas obtained, where they have obtained their professional education, how long they have been teachers, how long they have been teachers at the current school, what courses they teach and what types of classes they teach. The variable was rounded to whole numbers. Further missing values were imputed as for class size (see above).

Teacher speaks local language

Analogous to class size (see above).

Male teacher

Analogous to class size (see above).

Teacher job experience

Information on teacher job experience was only asked in the first three waves of the panel 95/96, 96/97 and 97/98. Imputation using Stata's impute command using teachers' information on their gender, age, civil status, living status (alone, with family), living location, professional status, diplomas obtained, where they have obtained their professional education, how long they have been teachers at current school and what courses they teach. Remaining inconsistencies have been imputed by calculating the mean value per class and attaching the maximum value for average values nearer to the maximum value and minimum values otherwise.

Media availability

Same as for property at home (see above).

Student speaks French at home

Same as for property at home (see above).

Languages-student

Same as for property at home (see above).

Work at home

Information on the components of this variable is available from the student questionnaires in 95/96, 97/98 and 99/00, that is from the first, third, and fifth wave of the panel. Missing

values have been imputed by assigning the value of the preceding year. For the remaining missing values, the value of the succeeding years (if non-missing) has been assigned.

Meals

The variable meals consists of the components breakfast, lunch and dinner. Value 0 denotes that they never have the respective component, value 1 regularly and value 0.5 that they have it sometimes. Breakfast was constructed from questions to the students if they have breakfast and if they have a snack at recess. If they have one or the other regularly or if they have both sometimes, the value 1 was given to the observation. If they have one of the two sometimes and the other one never or information on the other one is missing or if both are missing, value 0.5 was assigned. Lunch was assigned value 1 if students have lunch regularly and 0.5 if they have it sometimes or if this information was missing. Dinner was constructed in the same way as lunch. Since these questions have only been asked in 95/96 and 97/98, missing values of 96/97 have been assigned the values of 95/96 and missing values of 98/99 and 99/00 have been assigned the values of 97/98.

Double shift

No imputations.

Study at home

The variable study at home consists of the components *student studies at home* and *student gets help with studies at home*, which were asked in the student questionnaires of 95/96, 97/98 and 99/00. The missing values of 96/97 have been assigned the respective values of 95/96 and the missing values of 98/99 were assigned the respective values of 97/98. Remaining missing values have been assigned the values of the previous years.

Number of students/partnerships/teacher meetings

There is a questionnaire with questions to directors in 98/99. However, there is no information on these three variables, so I have used the first wave answers (from the 95/96 director questionnaire) as proxies for the complete panel. There is also a director's questionnaire for the last wave of the panel. However, this one is not relevant for my estimations.

Number of students

Imputed using variables indicating the number of teachers at school, the number of classes at school and the number of girls at school (then the variable was rounded to whole numbers).

Partnerships

No imputations.

Teacher meetings

Inconsistencies in the frequency have been replaced by choosing the more frequent value. (For example, if meetings take place once a week, they cannot also take place once a month. If both were selected simultaneously I opted for once a week.)

Other editing

Some variables were needed to identify the observations. Specifically the variable *wave* denotes which wave is currently considered. This variable is inconsistent in the case of four students where it jumped ahead (for example from 2 to 4). These observations were dropped as it is not clear how to use them in the final analysis. Missing values of the variable denoting the grade the student is currently attending were assigned the value 2 in the first wave of the panel (in 95/96) and 3 in 96/97. As there was also no student questionnaire in 98/99, information on the grade of the students from 97/98 and 99/00 were used to infer the grade in 98/99. Further missing values were filled with the information on grades from the test files. Remaining inconsistent values were assigned the value of the previous year if the student was a repeater. Moreover, in a few cases there were repetitive values of the student identification number within a class, which had to be deleted to be able to unambiguously identify each student. The variable *dropout* was needed for some of the data management and also for the simulations of dropouts in one of the robustness checks. Students were considered to have dropped out if they were not in the sample for two consecutive years and if they did not reappear later.

3 Occupational Choice, Remittances and Human Capital

3.1 Introduction

In chapter 2, I have looked at the problems of an education system with high retention rates that may suffer from overcrowding, generate high costs for the government and households and lead to lower achievement or even dropout of students. Of course, increasing educational attainment and quality has an intrinsic value but it is also highly relevant for the labor market decisions of individuals. This chapter looks at the moderating effect of education on the relationship between remittances sent by migrant household members and labor market outcomes of non-migrant recipients. Remaining in the African context, Senegal is again used as the country of analysis.

The flow of remittances to Africa has increased tremendously in the last decade, with the size of these flows having intermittently surpassed those of FDI and official aid (see Ratha et al., 2011). In a number of African countries they amount to more than 5 percent of GDP and they are less volatile than aid flows and FDIs (see Gupta, Pattillo, and Wagh, 2009). For Senegal, remittances flows increased substantially in the first decade of this century as did their share in the country's GDP. Remittances surged more than five-fold from USD 233 million in 2000 to USD 1,437 million in 2011, with a peak in 2008. In terms of economic performance, remittances amounted to 5 percent of GDP in 2000 and marked 10 percent in 2011 (UNCTAD, 2013; World Bank, 2013). This stands in contrast to the development of aid flows and FDI. While the former decreased from 6 percent of GDP in 2000 to 4 percent of GDP in 2011 (OECD, 2012; World Bank, 2013), FDI increased by a mere percentage point to

2.34 percent of GDP during this period (UNCTAD, 2013; World Bank, 2013). The rise in total remittances comes as no surprise as the number of Senegalese migrants appears to be increasing. Migration to OECD countries has doubled in the same period from roughly 9,000 people to more than 19,000 annually (OECD, 2014). The steep upward trend within this time span suggests that the increase of remittances flows may further proceed.

What effects do these massive money transfers by migrants have on the economic behavior of non-migrant family members, especially in relation to labor supply and occupational choice?

The existing literature on the relationship between remittances and labor market outcomes yields divergent results. Much of the literature argues that an increase in the reservation wage due to the receipt of remittances induces individuals to supply less labor (e.g. Funkhouser, 1992; Acosta, 2006; Amuedo-Dorantes and Pozo, 2006; Rodriguez and Tiongson, 2001; Binzel and Assaad, 2011; Kim, 2007; Jadotte, 2009). However, the results are mixed. Some find that remittances decrease labor force participation in general (Jadotte, 2009; Kim, 2007; Rodriguez and Tiongson, 2001), while others find differential effects by gender (Funkhouser, 1992; Amuedo-Dorantes and Pozo, 2006) or no effect of remittances on wage income (Yang, 2008).

In this chapter I develop a model that reconciles the contradictory results of the remittances literature, linking its currently prevalent theory to insights from the literature on the labor market behavior of return migrants (e.g. Massey and Parrado, 1998; Ilahi, 1999; McCormick and Wahba, 2001; Dustman and Kirchkamp, 2002; Mesnard, 2004; Mesnard and Ravallion, 2006). This body of work argues that alleviating credit constraints enables return migrants to enter entrepreneurial activities. Parts of the literature also apply this argument to the entry into self-employment of non-migrant family members receiving remittances (e.g.

Funkhouser, 1992; Amuedo-Dorantes and Pozo, 2006; Acosta, 2006; Jadotte, 2009). In this chapter, these two arguments are explicitly combined with one another. I show that under plausible assumptions human capital is a decisive factor in explaining in which cases the argument of labor-decreasing reservation wages weighs stronger than the rationale of self-employment enhancing alleviation of credit constraints. In a formal theoretical model I combine the arguments of the remittances and return migration literature on reservation wages and credit constraints with the theoretical and empirical literature on occupational choice.

In a second step, I examine data on Senegalese individuals in migration and non-migration households from a World Bank survey carried out in 2009 to test the theoretical predictions. Thereby, this chapter also contributes to the improvement of the econometric approach in the existing empirical literature as it includes both considerations of selection problems regarding migration households and endogeneity concerns with respect to remittances. The bias arising when neglecting either issue may be considerable and creates doubts about the validity of the estimates found in the literature. In addition, to the best of my knowledge, this is the first large country-level study on the effects of migrant remittances on labor supply and occupational choice of non-migrant family members in Sub-Saharan Africa. It is a particularly interesting region to study the importance of human capital in this context, given that education levels across the population are highly heterogeneous.

The results of the analysis suggest that an increase in remittances of 100,000 West-African Francs or about 219 US Dollars increases the likelihood of self-employment by about 12 percentage points or 24 percent, while decreasing the likelihood of wage employment by about 12 percentage points or about 32 percent for men with education levels above primary schooling. They do not show an effect on men with no education or on women independently of the level of education. These results show that self-employment will be preferred for highly

educated men who receive remittances. The lack of this effect for women may be a result of their role in a traditional society. Empowerment of women in the labor market, however, may also make the theoretical dynamics applicable to women in the future.

The literature on labor markets in developing countries emphasizes their heterogeneity and the necessity to distinguish between different segments. Decent wage employment opportunities are rare and therefore many people enter self-employment. Jobs in developing countries often do not only pay little but are also uncertain. Moreover, the employment situations of women are often worse than those of men (Fields, 2001, p.S17; Banerjee and Duflo, 2011). One reason why wage employment opportunities are very scarce appears to be the slow creation of new jobs in contrast to the increase of school enrolments. Bennell (1996, p.188, Table 5) shows that school enrolment increases were four times higher than the increase in wage jobs in the same period for Senegal, and most of Sub-Saharan African countries displayed similar patterns. While there have been further increases in wage employment since Bennell undertook his study, the share of wage earners in the Senegalese economy was still at a low 17.4 percent in 2005 (International Labour Organization, 2010, p.13). These dynamics suggest that taking account of different segments in the labor markets in developing countries is important when studying the effects of remittances on labor supply and occupational choice.

The literature emphasizes that reservation wages may increase when non-migrant family members receive remittances because they can afford the same consumption level as before while supplying less labor. As a consequence it is expected that the higher the amount of remittances the more consumption needs are satisfied and the less labor is supplied. A number of studies has researched these adverse effects with varying results.

Funkhouser (1992) for Nicaragua and Acosta (2006) for El Salvador find that remittances decrease labor force participation for women but that this is not the case for men. Rodriguez and Tiongson (2001) find that migration per se and remittances decrease labor supply of both men and women in the urban Philippines and similarly Kim (2007) finds that remittances generally decrease labor force participation in Jamaica. A negative effect is also found by Jadotte (2009) for Haiti. Regarding Sub-Saharan Africa, Azam and Gubert (2005) show that in eight villages in the Kayes region in Western Mali, the possibility of receiving remittances due to family members who have migrated is an insurance mechanism and leads to worse agricultural performance, which is likely to be a result of lower work effort.

On the other hand, several authors have researched the idea that remittances may alleviate credit constraints and may be used as start-up capital for businesses – also with varying results. Funkhouser (1992) finds that remittances increase self-employment among men but not among women. Massey and Parrado (1998) show that receipt of US earnings by migrants increases the odds of business formation and productive investment at the household level. In contrast, Amuedo-Dorantes and Pozo (2006) show that remittances reduce male urban self-employment in Mexico, whereas they do not have an effect on women.

More prominently, the idea of start-up capital is researched in the return migration literature. The savings of returning migrants in Turkey are an important source of start-up capital in micro-enterprises (Dustmann and Kirchkamp, 2002). The authors demonstrate that remittances may loosen financial restrictions and mitigate capital market imperfections, thus providing the necessary financial means to open (small) businesses. In the North-African context, Mesnard (2004) and Mesnard and Ravallion (2006) find a positive connection between savings of returning migrants and entry into self-employment in Tunisia. Similar evidence is also found for Pakistan by Ilahi (1999).

As is evident from this overview of the literature, the relationship between migration, remittances and employment is not yet established in the context of Sub-Saharan Africa. The employment situation in Senegal, as in much of Sub-Saharan Africa, is tense, with high unemployment, low wages and a sizable informal sector (see, for example, Some, 2009).

Against this backdrop, I analyze under what circumstances remittances alter the labor market decisions of members of migrant households who are left behind. I argue that the impact of remittances depends decisively on the level of human capital of the individual. This is in stark contrast to the existing literature, which has generated ambiguous results concerning the likelihood of wage- and self-employment. I propose two main arguments. The first is that additional income from migrants outside the household may be used for (self-) employment-generating investments in micro-enterprises or other businesses, where these investments may only be usefully made with at least a minimum level of knowledge acquired at school (e.g. in math, reading and writing). The second is that, for more highly skilled individuals, transfers may increase labor effort as the expected utility from increased output outweighs the benefit from more leisure, which serves as a substitute for labor. In contrast, lower skilled individuals are more likely to decrease their work effort in favor of leisure because they can afford less labor at equal consumption and entry into self-employment appears less promising.

The empirical identification of these effects is not trivial. On the one hand, migration and non-migration households may differ and this may be the true reason for differential labor supply and occupational choice. Moreover, the incidence and amount of remittances are subject to endogeneity concerns.[20] However, most of the existing studies have not accounted

[20] In addition, almost all of the literature uses cross-sectional survey data that make clear identification strategies even more important. Yang (2008) is an exception in this context as he is able to combine information on

for one or the other source of bias.[21] I specify Heckman selection models (Heckman, 1979) to address selection and instrument remittances using migrant characteristics.

The following section will provide a theoretical framework for analyzing the moderating effect of human capital on the impact of remittances on labor supply and occupational choice. After a brief description of the data in section 3.3, I explain the methodology applied in section 3.4. The results are discussed in section 3.5, with the conclusions following in section 3.6.

3.2 A theoretical model on remittances and labor choices

To illustrate the expected labor supply and occupational choice-related decisions in response to the receipt of remittances for different human capital levels, I use a straightforward extension of the standard labor-leisure model (see, for example, Borjas, 2013).[22] In this adapted model I consider the recipients of transfers, who are all family members above 15 years who were left behind in the country of origin. These individuals provide labor and receive income (or output) that may be used for consumption. The higher the labor supply the more income is generated and the more may be consumed. Each individual derives utility from leisure L and consumption C. Utility monotonically increases in both and marginal utilities diminish in C and L, that is $\frac{\partial U}{\partial L} > 0, \frac{\partial U}{\partial C} > 0,\ \frac{\partial^2 U}{\partial L^2} < 0, \frac{\partial^2 U}{\partial C^2} < 0.$

migrant and non-migrant household members from two time periods. However, he does not study labor force participation and confines his analysis to migrant households.

[21] Jadotte (2009) is an exception as he predicts the number of migrants in the first stage and uses this variable as one of the instruments for remittances. In this way, however, the author only tackles the part of selection that affects non-migrant household members via remittances.

[22] The model is also related to the literature on occupational choice under liquidity constraints (Evans and Jovanovic, 1989) and to recent literature on entrepreneurship in Sub-Saharan Africa (Alby et al., 2013). These studies only consider the decision between self- and wage employment and hence do not allow for unemployment. The present study embeds the labor decisions in a model of consumption and leisure and therefore explicitly considers the possibility of unemployment.

Moreover, cross derivatives are assumed to be positive: $\frac{\partial^2 U}{\partial L \partial C} > 0, \frac{\partial^2 U}{\partial C \partial L} > 0$. Individuals who invest may consume the output of their production function $Y = \theta\, f(R, L_0 - L)$ in which remittances R are used as capital input, θ denotes individual skills or education, and L_0 denotes the total time budget so that $L_0 - L$ is the amount of labor supplied. The function f is increasing and concave with respect to both of its arguments. For the purpose of illustration, we may use the Cobb-Douglas specification, $C = Y = \theta\, R^{\alpha} \left(L_0 - L\right)^{1-\alpha}$, where α lies within the unit interval. I follow Alby, Auriol, and Nguimkeu (2013) in assuming that businesses are generally credit constrained in Sub-Saharan Africa. If individuals choose to become self-employed they will invest all of the remittances they have received in their business. In case they choose wage employment they will receive a given wage w.[23]

Individuals face the following constrained maximization problem:

$$max\, U(C, L) \qquad (3.1)$$

$subject\ to$

$$\mathrm{C} = \begin{cases} \theta\, R^{\alpha} \left(L_0 - L\right)^{1-\alpha} & self - employment \\ w \left(L_0 - L\right) + R & wage - employment \\ R & unemployment \end{cases} \qquad (3.2)$$

$$with\ R > 0, \theta > 1\ and\ \alpha \in (0,1)$$

Obviously, the more individuals work the more they will earn and consume, irrespective of their occupational choice. Utility is maximized by choosing the optimal

[23] The assumption that this wage w is fixed will be relaxed later.

amount of leisure and consumption. I will compare the utilities form three cases: Self-employment, wage employment and unemployment.

Case a: The individual chooses self-employment and invests all remittances received. The maximization decision reduces to :

$$max_L\ U^a\ (\theta\ R^\alpha\ \left(L_0 - L\right)^{1-\alpha}, L)\ . \qquad (3.3)$$

The first order condition therefore is

$$FOC_a: \frac{\partial U^a}{\partial L}\ =\ -(1-a)\ U_1^a\ \theta\ R^\alpha\ \left(L_0 - L\right)^{-\alpha}\ +\ U_2^a\ =\ 0, \qquad (3.4)$$

where U_i is the derivative of U with respect to its i'th argument. Let L_1^* be the amount of leisure that maximizes the utility function U^a.

Case b: The individual chooses wage employment. The maximization decision is

$$max_L\ U^b\ (w\ \left(L_0 - L\right) + R, L) \qquad (3.5)$$

The first order condition therefore is

$$FOC_b: \frac{\partial U^b}{\partial L}\ =\ -U_1^b\ w + U_2^b\ =\ 0 \qquad (3.6)$$

Let L_2^* be the amount of leisure that maximizes the utility function U^a.

Case c: The individual chooses unemployment. In this case utility is simply

$$U^c(R, (L_3 = L_0). \qquad (3.7)$$

Summarizing, we have an expression for maximum utility for both types of occupation and for unemployment:

$$U^{a^*,b^*,c^*} = \begin{cases} U^{a^*} = U\left(\theta\, R^{\alpha}\left(L_0 - L_1^*\right)^{1-\alpha}, L_1^*\right) & self-employment \\ U^{b*} = U\left(w\left(L_0 - L_2^*\right) + R, L_2^*\right) & wage-employment \\ U^{c*} = U\left(R, (L_3^* = L_0)\right) & unemployment \end{cases} \qquad (3.8)$$

It is essentially the comparison of these three utility levels that induces individuals to opt for one type of employment or the other, if at all. It is easy to see that the amount of remittances and the skill level will play a decisive role in this choice. The model allows us to establish a number of insights that will be discussed in detail. I start by putting aside the possibility of unemployment in order to focus solely on occupational choice for the moment. We can state

Proposition 1: The impact of an increase in R on occupational choice depends on the degree to which the investment enhances income from self-employment

Proof: Since consumption strictly increases in R and utility strictly increases in consumption, utility also strictly increases in R, that is $\frac{\partial U^a}{\partial R} = \frac{\partial U^a}{\partial C^a}\frac{\partial C^a}{\partial R} > 0$. Similarly, we have $\frac{\partial U^b}{\partial R} = \frac{\partial U^b}{\partial C^b}\frac{\partial C^b}{\partial R} > 0$. To increase the likelihood of self-employment in response to an increase in R, we need: $\frac{\partial U^b}{\partial R} < \frac{\partial U^a}{\partial R} \Leftrightarrow \frac{\partial U^b}{\partial C^b}\frac{\partial C^b}{\partial R} < \frac{\partial U^a}{\partial C^a}\frac{\partial C^a}{\partial R} \Leftrightarrow \frac{\partial C^a}{\partial R} > \frac{\frac{\partial U^b}{\partial C^b}\frac{\partial C^b}{\partial R}}{\frac{\partial U^a}{\partial C^a}}$.

This shows that receiving remittances by itself and therefore alleviating credit constraints does not clearly indicate that one type of employment or the other would be preferable. The intuition behind this result is simple. Each individual obtains income from

self-employment depending on their respective production technology. For some individuals an additional unit of investment may increase output by a large amount, even for higher levels of remittances. For others the production technology may be very flat and wage employment therefore preferable. Let θ^I be the skill level at which individuals are indifferent between both types of occupation. We can state

Proposition 2: For a given $R > 0$, an individual choses self-employment if and only if $\theta \geq \theta^I$.

Proof: Since $C^a = \theta R^\alpha \left(L_0 - L\right)^{1-\alpha}$, consumption in self-employment is a strictly increasing function of θ and as $\frac{\partial U^a}{\partial C} > 0$, we have $\frac{\partial U^a}{\partial \theta} > 0$. In contrast, since $\frac{\partial U^b}{\partial \theta} = 0$, an increase in θ does not affect U^b. □

In this second proposition, I am specifically interested in the composition of the production function. Higher skills clearly increase output from production and therefore the likelihood of choosing self-employment for the highly skilled is higher when credit constraints are alleviated by means of remittances.

Let us now reintroduce unemployment. More specifically, I will start by considering a situation where wage employment opportunities exist for anybody willing to work. Starting with wage-employed individuals, we know that $U^b = U^b(w\left(L_0 - L\right) + R, L)$ and as above the respective first order condition is $\frac{\partial U^b}{\partial L} = -U_1^b\, w + U_2^b = 0$ and L_2^* maximizes utility in wage employment. To see how leisure decisions react to changes in the amount of remittances received, we can use the implicit function theorem. We have

$$\frac{\partial^2 U^b}{\partial L^2} = U_{11}^b w^2 - U_{12}^b w - U_{21}^b w + U_{22}^b < 0 \qquad (3.9)$$

as well as

$$\frac{\partial^2 U^b}{\partial L \partial R} = -U_{11}^b w + U_{21}^b > 0 \qquad (3.10)$$

and therefore

$$\frac{\partial L}{\partial R} = -\frac{-U_{11}^b w + U_{21}^b}{U_{11}^b w^2 - U_{12}^b w - U_{21}^b w + U_{22}^b} > 0. \qquad (3.11)$$

We thus obtain the well-known result that an increase in non-labor income (remittances in this study) decreases the labor supply of the respective individual.

Next, let us consider self-employment. From proposition 1, we know that if $\frac{\partial U^a}{\partial R}$ is too small, wage employment is preferred and labor supply behavior is according to the case of wage employment. From proposition 2, we know that $\frac{\partial U^a}{\partial \theta} > 0$ and for some skill level θ, which is sufficiently high, an individual chooses self-employment as $U^a > U^b$ and there will be some (R, θ) combinations for which the utility of self-employment is higher than those of wage employment or unemployment, that is $U^a > U^b > U^c$. Furthermore, abstracting from the possibility of a switch from self-employment to wage employment, we thus state

Proposition 3: For a constant skill level θ at self-employment, a further increase in R will at some level of R, which is high enough, lead to a switch to unemployment.

Proof: Due to the concavity of U with respect to C and the concavity of the production function $\theta R^{\alpha}(L_0 - L)^{1-\alpha}$ with respect to R for the self-employed, and as C is a linear

function of R for the unemployed, we know that the marginal increase in utility from remittances will be higher for the unemployed than for the self-employed at some level of R.□

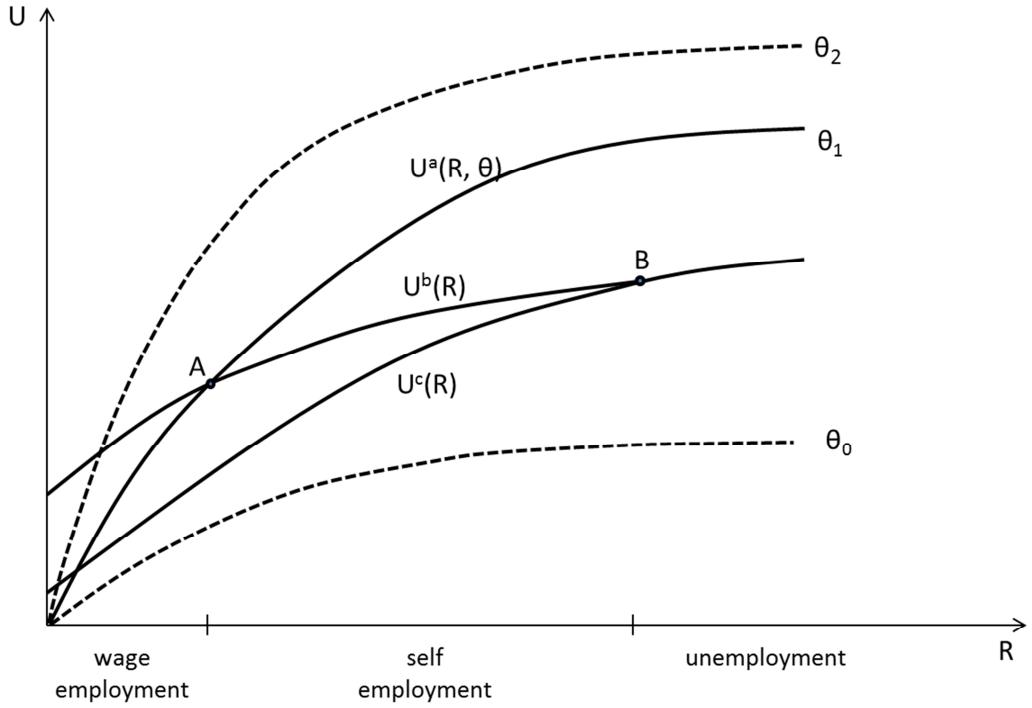
Clearly, if we consider a constant skill level at self-employment, an increase in remittances could also first lead to a switch to wage employment and, finally, for further increases in remittances, to unemployment. As is evident from proposition 2, this becomes less likely the higher the skill level θ.

Figure 3.1 illustrates the implications of the model that I have derived so far. The abscissa indicates the level of remittances received and the ordinate the level of utility. The functions drawn show the level of utility attained depending on the type of employment, the skill level of the individual and remittances. We can see that utility for the self-employed U^a is initially very low for very small amounts of R. Since they do not have the capital to invest productively, they would rather choose to be wage-employed. The wage-employed have higher utility ($U^b > U^a$) even without remittances since they are employed and obtain a wage w irrespective of R. If the skill level is very low, for example at θ_0, self-employment will never be chosen as both wage employment and unemployment will be preferable. In the case of very high skill levels, individuals enter self-employment for low amounts of remittances as indicated by the curve of individuals with skill level θ_2.

The reason for this is that production is very efficient for more highly skilled individuals. The abscissa shows the occupational choices for the respective amounts of remittances and the skill level θ_1. Point A indicates occupational indifference for these individuals. Fewer remittances than in point A will make wage employment more attractive, whereas self-employment will be chosen for higher values of R. Unemployment is indicated

for all those who would choose one type of occupation or the other for values of R below point B but whose (R, θ) combinations are below $U^c(R)$ for higher values of R.[24]

Figure 3.1: Occupational choice and unemployment



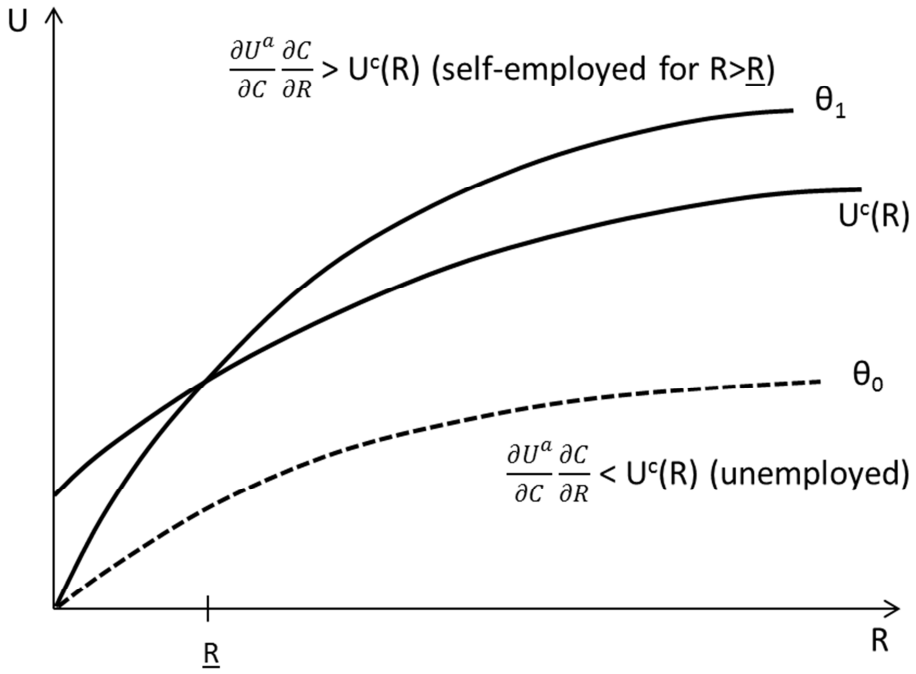
As a next step, let us consider a situation in which only limited wage employment opportunities exist. Anyone, however, may become self-employed if they wish to do so.

[24] A note on the assumption that businesses are generally credit constrained: Even though this assumption has been made in the theoretical literature (see, for example, Alby et al., 2013) it may appear strong. However, allowing individuals in this model to choose any combination of R for investment in businesses and consumption would strongly complicate the model. An alternative technical assumption that constitutes a sufficient condition to attain very similar results would be to assume that $\frac{\partial U^a}{\partial R} > \frac{\partial U^c}{\partial R}$ for any θ greater than a threshold of skills θ^T. For skills below this threshold ($\theta < \theta^T$), we would need to assume that $\frac{\partial U^a}{\partial R} < \frac{\partial U^c}{\partial R}$. Obviously, these are the bounds within which much weaker scenarios hold as well. Moreover, there are also non-technical reasons to believe that R may indeed be fully used up in a business. Analogously to the arguments set forth in Alby et al. (2013) and the literature cited therein, individuals in African societies have an incentive to hide their wealth in order to avoid obligatory sharing with (extended) family members. If they receive remittances and invest in a business they show their financial possibilities. However, if they do not invest all or a substantial amount in the business, members of their social network may ask for parts of what is left. In contrast, profits from an investment are much less visible and can therefore be hidden more easily.

Those affected by this limit, that is those who do not find a wage job, will be unemployed if $R = 0$ since they cannot start a business or the like. If $R > 0$, self-employment becomes possible at any skill level θ and will be chosen if $U^a > U^c$.

Figure 3.2 illustrates this alternative situation. For $R > 0$, self-employment is chosen if $\frac{\partial U^a}{\partial C}\frac{\partial C}{\partial R} > \frac{\partial U^c}{\partial R}$, which will once again be the case if the output from an additional unit R in production is sufficiently high. As before, this likelihood increases in θ. This case is particularly relevant in Sub-Saharan Africa where wage employment opportunities remain scarce and self-employment is very widespread (as explained in section 3.1).

Figure 3.2: Self-employment and unemployment



Finally, let wages be a function of the skills similar to the production function, since it is likely that higher skill levels will increase wages of employees.[25] In this case the relative efficiency of using skills in self-employment as opposed to using them in wage employment becomes decisive for the selection of one type of occupation or the other. If the relative efficiency of skills in self-employment is higher, then we have the situation as above. If, however, wage increases are comparatively high with rising skill levels, then wage employment will become the more attractive choice. In this case a non-linear effect of remittances on employment type with respect to education may be expected. By putting more emphasis on the first case during the exposition of the model, I have implicitly displayed the assumption that skills will more likely play an important role in the case of a business start-up than in the case of wage employment. One important reason for this assumption is the narrow opportunity for wage employment, whereas entry into self-employment is unlimited.

From a slightly different theoretical point of view, higher education or higher skill levels of an individual could be associated with increased intrinsic motivation to work as opposed to lower levels of education. This may be the case if, at a given place of employment, highly skilled individuals need to expend less effort to finish the tasks involved in the job than those with fewer skills or if the latter feel overburdened by the workload more easily as they are not sufficiently educated to comfortably undertake the work activities. In this case, the utility from leisure as compared to consumption will be higher for those with fewer skills than for the highly skilled. This would not change the underlying dynamics of the model as elaborated above but it will likely change the exact amounts of remittances or skill levels that induce an individual to change occupation or to become (un-)employed. For example, if

[25] See Jovanovic (1994) for a detailed discussion on the correlation between managerial and working skills.

leisure is very important, unemployment may be chosen for lower levels of remittances since consumption needs may be satisfied easily and labor appears highly burdensome.

Let us summarize the implications of the model. Non-migrant household members may receive remittances. If they do not receive any, they cannot become self-employed since they lack the means for investment. If they do receive remittances, they will compare the three alternatives they have. The remittances alleviate credit constraints but if their skill or educational levels are very low, they do not know how to efficiently use these means to obtain a high income. They will subsequently choose wage employment or, if remittances are sufficiently high, they may even prefer unemployment. If their skill levels are high enough, then the combination of remittances that alleviate their credit constraints on the one hand and efficiency in their business that originates from their skills on the other hand will make self-employment appear the more attractive choice.

Moreover, and specifically relevant for Sub-Saharan African countries, if wage employment opportunities are very scarce the choice essentially reduces to one between self-employment and unemployment. The latter will be more likely if the former needs at least some basic skills like reading, writing or math and if individuals do not possess these.

The standard theoretical framework of labor economics when dealing with labor decisions is that of a trade-off between labor and leisure. Individuals would like to consume a certain amount of goods, for which they will have to supply labor and receive wages. In the context of remittances, capital sent from former household members who have migrated may substitute for part or all of the wages earned on the labor market and make leisure the more attractive choice as opposed to working.

While this standard theory explains why individuals may reduce their work efforts, it nonetheless lacks the opportunity (or ability) perspective that complements this theoretical

framework. I have introduced and formalized this ability perspective in terms of the differential response between the highly skilled and those with low skill levels to remittances sent from household members who have migrated. While additional means are useful as start-up capital for micro-enterprises or productivity-enhancing investments, it is also likely that these investments need prior knowledge to be success- and purposeful. For a small enterprise, we would expect the individual starting this enterprise to have a minimum body of knowledge in writing, reading and arithmetic to be able to order and buy products, to negotiate prices and for simple accounting. Without these basic skills individuals are much less likely to risk an undertaking of this scope, however small it may seem in absolute terms. This hypothesis is highly relevant in Sub-Saharan African countries where literacy levels and enrolment rates remain low. Specifically, consider the case of illiterate individuals without training in math as they have never attended school but who work as street vendors where income is extremely low. In such a case, financial flows from a former household member who has migrated may enable them to afford the necessary consumption goods without any further labor, meaning they may therefore retreat from the labor activity. In contrast, considering primary school graduates who are willing to work but who do not find an opportunity corresponding to their qualifications, additional income may open up the opportunity to start a micro-enterprise. This will be considered if the utility of the expected returns from such an investment is assumed to exceed the utility in the case where remittances substitute for some or all of the labor activity.

We can of course think of situations where formal education is less important because it is not directly used in the tasks of one's work, as for example in some service jobs. However, basic knowledge on arithmetic may also be useful for a taxi driver who will need to calculate and estimate revenue relative to investment costs for a car and gasoline prices. Or consider self-employed tourist guides who will not directly need any skills from school since

they know the location of the important places of interest. Nevertheless, the ability to read a map or a sign may tremendously increase their efficiency and their revenues. Many other examples with similar implications are conceivable.

The following sections of this chapter elaborate on the operationalization and the empirical application of this theoretical framework in the context of Sub-Saharan Africa. The aim is to test the hypothesis that human capital has a moderating effect on the impact of remittances on labor supply and occupational choices in Senegal. We may expect more highly educated individuals to be more likely to enter self-employment in response to remittances that alleviate their credit constraints. In contrast, the less educated are expected to withdraw from labor activities.

3.3 The data

This analysis uses the Migration and Remittances Household Survey 2009 carried out by the Consortium Pour La Recherche Économique et Sociale (CRES) and funded by the World Bank (World Bank, 2009).[26] In an effort to shed light on the issue of remittances in Sub-Saharan Africa, the World Bank and CRES questioned all of the members of roughly 2,100 Senegalese households, of which about 700 were non-migration households and 1,400 were migration households. The data therefore contain information on 17,878 non-migrants and 2,277 migrants. The data are nationally representative in the sense that all geographical areas have been covered. Two major problems are usually encountered with remittances data. First, as Gupta et al. (2009, p.104) stress, the official remittances flows to a country may actually be "destined for neighboring countries". Second, Freund and Spatafora (2008) estimate that the

[26] This section draws from World Bank and CRES (2009, p.3).

share of informal remittances to Sub-Saharan Africa is relatively high. Since the World Bank data are directly collected from the households, we do not worry about these two issues. Just like the data of most studies in this context these data are cross-sectional, that is respondents were not followed over several years. This has some implications for the choice of the estimation technique that need to be considered (see section 3.4).

Table 3.1 shows summary statistics of the variables used in the analysis. The variables are illustrated for the adult population in the sample, i.e. for those aged 15 or above. The key variables for the purpose of this study are *wage employment*, *self-employment*, *education* and *remittances per capita*. *Wage (and self-) employment* are dummy variables that take the value 1 if the individual is wage (or self-) employed and 0 otherwise. These variables are defined as full-time employed or part-time employed. Unemployment is defined as unemployed individuals and those taking care of the household. Full-time students, long-term sick or people with disabilities as well as those serving in the military or working as civil servants have not been defined for this variable. Education has three distinct categories: No education and illiterate; at least some primary education but not completion of the primary school cycle (or no education but literate) and, as a third category, at least completion of six grades (i.e. the primary school cycle) with success.

Furthermore, the table shows summary statistics for the migrants. As there are several migrants for a number of households I take the mean values of their employment status, their age and their destination country. For example, if there are two migrants in one household the variable *mean age* indicates the arithmetic mean of the ages of these two migrants. If there is only one migrant the variable would indicate the age of this individual. For the length of the duration of migration I consider the migrant with the longest duration.

Table 3.1: Summary statistics of households, adult household members in Senegal & migrants

	Mean	Standard Dev.	Minimum	Maximum	N
Characteristics of adult household members in Senegal					
remittances p.c. (in 100.000 XOF)	0.75	1.81	0	44	8270
self-employment	0.46	0.50	0	1	8270
wage employment	0.14	0.34	0	1	8270
female	0.59	0.49	0	1	8270
education (categories)	0.80	0.89	0	2	8270
age	35.30	14.16	15	90	8270
Characteristics of households in Senegal					
Dakar	0.26	0.44	0	1	8270
other urban areas	0.35	0.48	0	1	8270
wealth	-0.06	1.62	-2.4	5	8270
no. of children at migration	3.82	3.24	0	29	8270
household size at migration	9.67	5.95	0	57	8270
share of migration households in region	0.61	0.19	0.1	1	8270
Characteristics of migrants					
female	0.22	0.41	0	1	2277
mean employment	0.78	0.35	0	1	2145
mean age (years)	34.22	10.10	5.0	99	2277
duration (max)	10.61	9.17	0.1	69	2259
Africa (mean)	0.18	0.33	0	1	2259
non-Africa (mean)	0.33	0.43	0	1	2259

Note: The table shows values for the unweighted data sample (estimations below generally include weights). The wealth index is calculated from a principal component analysis carried out using long-term household characteristics that indicate wealth (such as whether a household possesses a separate room for cooking, electricity, agricultural land, non-agricultural land, a house, other buildings, a refrigerator, air conditioners, a computer, a car/truck and/or a tractor/harvester). In this way I try to avoid capturing wealth that is induced by the receipt of remittances. (Correlation between the wealth index and remittances p.c. is only 0.2). The number of children per household and the number of household members are counted at time of first migration for migration households and at time of data collection for non-migration households. Education is a categorical variable taking a value of 0 for those without education and the illiterate (*no education*), a value of 1 for those who have completed at least one grade and a maximum of five grades with success (*low education*), and a value of 2 for those who completed at least six grades (i.e. the primary school cycle) with success (*high education*).

The mean value of schooling for non-migrants is 3.3 years. A considerable number of people in the sample did not successfully complete a single year at school (61 percent), mostly because they did not attend school in the first place.

3.4 Methodology

The relationship between remittances of migrants and labor supply of household members left at home is a complex one. An important aspect that has often been neglected in the literature on the remittances–labor supply nexus is selection into migration. Remittances are only observed for migration households. However, the characteristics of these households may differ from non-migration households and potential differences in labor supply may be a result of these differences. In addition, the literature often ignores other problems of endogeneity resulting from, for example, reverse causality, as the working decisions of family members at home may influence the amount of remittances sent by the migrant. Moreover, there may be endogeneity resulting from omitted demand-side factors of the labor market.

To my knowledge, almost none of the existing studies[27] tackle both problems simultaneously. I control for these issues in the following manner. Consider the following equation explaining employment Emp of a family member left at home:

$$\Pr(Emp_i = 1|R_i, E_i, X_i) = \Phi(R_i\alpha_R + E_i\,\alpha_E + (R_i * E_i)\alpha_{R*E} + X_i\alpha_X + \varepsilon_i) \qquad (3.12)$$

where $\mathrm{Emp_i}$ is a binary variable that denotes if individual i is employed or not. Employment can be self-employment, wage employment or employment in general depending on the estimation. $\mathrm{R_i}$ denotes the remittances the migrant has sent back home, and $\mathrm{E_i}$ is the educational attainment of the individual who receives the remittances. The

[27] Jadotte (2009) is an exception, but – as mentioned above – his procedure is likely to capture only parts of the selection effect. Furthermore, Massey and Parrado (1998) attempt to control for both selection and endogeneity in a somewhat similar fashion to the approach of this chapter. However, they only study business formation.

multiplicative term $R_i * E_i$ is an interaction term between remittances and educational attainment that is incorporated to test if the employment decisions differ for distinct values of educational attainment. X is a vector denoting other characteristics of individuals and their household and ε denotes a random error. Note that for the purpose of illustration I have included the interaction between remittances and education in the equations. In most of the estimations, however, I split the data into three categories of education (see section 3.3) and estimate the parameters of the model separately for each category. The reason for this choice is the complex estimation procedure detailed in the following paragraphs.

Concerning the first statistical problem, namely the selection bias, assume that the households who have sent a migrant abroad differ systematically from those households who have not. These differences in household characteristics may be the actual driving force explaining labor supply of family members. This problem can be solved using Heckman's (1979) two-step model. Accordingly, we may perceive this problem as being equivalent to omitted variable bias. I estimate the probability of being a migrant household in a first step as follows

$$\Pr(M_j = 1) = \Phi(N_j\,\beta_N + H_j\beta_H + \upsilon_j) \qquad (3.13)$$

where M is a binary variable indicating if household j has sent a migrant abroad or not and N is a variable that indicates the number of migrant households in a district in Senegal to proxy for migration networks of this district (see Hanson and Woodruff, 2003). Furthermore, H is a vector of household characteristics. Following Heckman (1979), I calculate the Inverse Mill's

Ratio ($\hat{\lambda}$)[28] from this equation that may be included in equation (3.12) as an additional variable and therefore corrects for selection.

Moreover, I address possible endogeneity from reverse causality or other sources by instrumenting for remittances. According to the underlying assumptions of the instrumental variable methodology, these variables have to be highly correlated with remittances and must not be correlated with the residuals from equation (3.12). I use migrant characteristics, such as whether they have a job in the country of current residence or their duration of migration, that are likely to be highly correlated with the amount of remittances sent.[29] Remittances are therefore regressed on these variables. As remittances are left-censored at 0, I use a Tobit model:

$$R_i = \begin{cases} R_i & if\ R_i^* = I_i\gamma_I + X_j\,\gamma_X + \mu_i > 0 \\ 0 & if\ R_i^* = I_i\gamma_I + X_j\,\gamma_X + \mu_i \leq 0\,, \end{cases} \qquad (3.14)$$

where R_i^* is a latent variable. The endogeneity problem arises if μ_i and ε_i are correlated. Following the two-step methodology of Rivers and Vuong (1988; see also Wooldridge, 2002, pp.472-474), I assume that (μ_i, ε_i) are bivariate normally distributed.[30] As in probit models, $Var(\varepsilon_i)$ is normalized to one. We can write $\varepsilon_i = \psi\mu_i + e_i$, where $\psi = Cov(\mu_i, \varepsilon_i)/Var(\mu_i)$ and e_i is independent of μ_i and all exogenous variables (including the instruments) and normally distributed with mean zero. A simple calculation shows that $Var(e_i) = 1 - \rho_i^2$,

[28] The Inverse Mill's Ratio $\hat{\lambda}$ is calculated as $\frac{\varphi(Z)}{\Phi(-Z)}$, where φ and Φ are, respectively, the probability density function and the cumulative distribution function of the standard normal variable Z and $Z = N_j\,\beta_N + H_j\beta_H$ (see Heckman, 1979; Van De Ven and Van Praag, 1981).

[29] The exogeneity of these instruments is discussed in subsection 3.5.3. In this context, I also apply an overidentification test.

[30] In the following sentences I show the adaptation of the model of Rivers and Vuong (1988) to my equations based on the explanations in Wooldridge (2002, pp.472-474).

where $\rho_i = Corr(\mu_i, \varepsilon_i)$. I predict the residuals from equation (3.14) as they are not observed. The predicted values $\widehat{\mu_i}$ from this regression are then used in the estimation of equation (3.12).[31] Together with the inverse Mill's ratio calculated from equation (3.13), equation (3.12) now reads:

$$\Pr(Emp_i = 1 | R_i, E_i, X_i, \widehat{\mu_i}) =$$

$$\Phi[(R_i\alpha_R + E_i\,\alpha_E + (R_i * E_i)\alpha_{R*E} + X_i\alpha_X + \hat{\lambda}_i\delta_{\hat{\lambda}} + \widehat{\mu_i}\,\alpha_{\widehat{\mu_i}})/(1 - \hat{\rho}_i{}^2)^{0.5}] \qquad (3.15)$$

where $\hat{\rho}_i = Corr(\widehat{\mu_i}, \varepsilon_i)$. This procedure consistently estimates all parameters divided by the factor $(1 - \hat{\rho}_i{}^2)^{0.5}$.[32]

I include several variables with respect to household and geographical characteristics that may explain if a household has a migrant or not (equation 3.13). Among the geographical variables, I include a dummy if the household resides in Dakar and a dummy if it resides in another urban area. The reference category is the rural area. Another geographical variable is the number of migrants as a share of total population in a district. This variable is meant to measure the strength of the migration network. In order to generate variation in this variable I have multiplied this share by the squared age of the household head of each household (see Hanson and Woodruff, 2003; Acosta, 2011). Hanson and Woodruff (2003, p.21-22) point out that household characteristics may be relevant for the migration decision and therefore are a suitable term for interaction with regional migration rates. This achieves variation in the household level but comes with the potential disadvantage that the household characteristics

[31] Note that since $\widehat{\mu_i}$ can only be estimated for migrants it is set to 0 for all non-migration households.
[32] Since the estimation procedure includes several estimation steps the standard errors are jackknifed in general. For robustness I also run alternative estimations with bootstrapped standard errors with 300 replications and obtain qualitatively very similar results.

used (in this case the square of the age of the household head) may be directly linked with labor decisions. For the household characteristics explaining migration, I include the number of children, the household size and a variable indicating the wealth of the household.[33]

For the estimation of the moderating effect of education on the impact of remittances on labor supply and occupational choice (equation 3.15), I generate a variable denoting three levels of education as noted above. First, an individual has not received any education at all, i.e. they did not attend school. Second, at least one year and a maximum of five years of primary school were completed with success. I add to this second category those who have not attended school at all but are able to read or write (they are not included in the first category). In a third category, those individuals are included who have at least finished sixth grade (the final grade of primary education) with success. The variable indicating the amount of remittances encompasses the sum of the transfers received from their former household members who have migrated and former non-household members who have migrated, as well as the value of the goods the household received from them. I divide this amount by the number of adult household members, that is, I use *per capita* remittances for the estimations. Further control variables are the *age* of the household member and the *number of children* currently in the household. Furthermore, as in the selection equation, I use dummies for *Dakar* and *other urban areas* as well as the *wealth* indicator. As we may expect differential results for men and women, I estimate separate models by gender. Moreover, since I expect distinct outcomes for different job types I differentiate between wage and self-employment.

[33] See the caption of Table 3.1 for the calculation of the wealth index, the number of children and the household size.

3.5 Results

3.5.1 General results

Table 3.2 shows the selection equation that is estimated to calculate the inverse Mill's ratio. The dependent variable indicates whether the household has currently at least one migrant living outside the household. I include a number of household characteristics to estimate the probability of being a migration household, namely: Residency in Dakar or other urban areas as opposed to rural areas, share of migrants in a district multiplied by the squared age of the household head, a wealth index, the number of children at migration and the number of household members at migration. Since the outcome equation differentiates between men and women, this selection eqauation also estimates separate models by gender. The estimation shows that all variables are highly significant at the one percent level (except age for female recipients) and therefore seem to be important in predicting migration for both men and women. The results are fairly similar across genders since the variable of interest is at the household level.

Moreover, I conduct an estimation explaining the size of remittances that are sent back to the household in the country of origin (equation 3.14). Table 3.3 shows that employed migrants and those whose migration dates back longer send significantly more remittances to their families back home. The reason may be that migrants have more money available when they are employed and that migrants who have resided in the destination country for a longer period have higher paid jobs. Moreover, migration outside Africa has a highly significant positive impact on the size of remittances, which is likely to be the result of higher remuneration outside Africa. In contrast, migrants whose families reside in Dakar send

significantly fewer remittances. Wealthier families (for females) and those with more children (for males) also receive more remittances.

Table 3.2: Selection equation for the probability of migration by gender of recipient

	(1)	(2)
migration	Male	Female
Dakar	-0.68***	-0.82***
	(0.20)	(0.19)
other urban areas	-0.47***	-0.57***
	(0.17)	(0.14)
share of migration households in region	0.55***	0.43***
	(0.07)	(0.08)
wealth	0.25***	0.28***
	(0.07)	(0.06)
no. of children at migration	0.23***	0.22***
	(0.05)	(0.04)
household size at migration	-0.16***	-0.15***
	(0.03)	(0.02)
age	-0.01***	0.00
	(0.00)	(0.00)
constant	0.49**	0.50**
	(0.24)	(0.24)
pseudo R-squared	0.20	0.19
observations	4,868	6,042

Note: Robust standard errors adjusted for clusters (districts) in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table 3.3: Variables explaining the size of remittances by gender of recipient

remittances p.c.	(1) Male	(1) Female
mean employment	4.05***	3.50***
	(0.71)	(0.75)
mean age	-0.02	0.01
	(0.03)	(0.03)
duration (maximum)	0.09***	0.08***
	(0.03)	(0.02)
Africa	-0.60	-0.25
	(0.57)	(0.63)
non-Africa	2.87***	2.60***
	(0.69)	(0.74)
age	0.01	-0.00
	(0.01)	(0.00)
Dakar	-1.84**	-2.23***
	(0.92)	(0.72)
other urban areas	-0.16	-1.22*
	(0.81)	(0.69)
wealth	0.49	0.73***
	(0.31)	(0.20)
no. of children	0.08*	0.05
	(0.04)	(0.03)
constant	-1.44	-0.40
	(1.16)	(1.07)
pseudo R-squared	0.09	0.10
observations	2,907	3,984

Note: Robust standard errors adjusted for clusters (districts) in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

3.5.2 Estimation results for male recipients

I now turn to the main estimations of the impact of remittances on employment of the household members in the origin country (equation 3.15). As the literature suggests, there are likely differential effects by gender. In this and the following subsection the results and their robustness are discussed for men. Subsection 3.5.4 elaborates on the results for women. The estimates are separately reported for high levels of education, low levels of education and no

education. The explanatory variable *remittances per capita* is divided into deciles for positive amounts of remittances in addition to zero remittances as its own category, resulting in 11 categories for this variable. An increase in this variable therefore reflects a substantial increase in the amount of remittances received.[34] In subsection 3.5.3 I test the robustness of this measurement to a number of alternative ones.

Table 3.4 is based on the two-step estimator by Rivers and Vuong (1988) detailed above. Columns (1) and (2) show that remittances lead to a higher probability of self-employment for highly educated men and men with low levels of education, whereas no effect can be found for men without education. The coefficients for the highly educated and those with low levels of education are significant at the five and ten percent level, respectively. Conversely, columns (4) and (5) reveal that highly educated men and men with low levels of education are less likely to be in wage employment when they receive remittances.

[34] Measuring transfers in deciles may be more appropriate than using the actual amount of remittances since there may be some fixed initial start-up costs for self-employment that require higher amounts of transfers (see Mesnard, 2004; Mesnard and Ravallion, 2006).

Table 3.4: Probit model accounting for selection & endogeneity (first-stage Tobit)

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.08****	**0.12***	**0.06**	**-0.09****	**-0.13***	**-0.07**
	(0.04)	**(0.07)**	**(0.07)**	**(0.04)**	**(0.07)**	**(0.07)**
age	-0.02**	-0.01	0.01	0.03***	0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dakar	-0.86***	-1.23**	-0.46	0.48	1.21*	0.04
	(0.33)	(0.51)	(0.42)	(0.31)	(0.65)	(0.53)
other urban areas	-0.72**	-0.26	-0.40	0.57**	0.29	0.26
	(0.29)	(0.42)	(0.28)	(0.27)	(0.56)	(0.35)
no. of children	0.04*	0.08	0.00	-0.04*	-0.04	-0.03
	(0.03)	(0.06)	(0.03)	(0.03)	(0.06)	(0.03)
wealth	-0.05	0.01	-0.45***	0.04	-0.04	0.41***
	(0.08)	(0.14)	(0.12)	(0.08)	(0.17)	(0.15)
residual	-0.11**	-0.05	-0.13	0.14***	0.01	0.13
	(0.05)	(0.08)	(0.08)	(0.05)	(0.08)	(0.08)
inverse Mill's ratio	0.40*	0.32	0.22	-0.22	-0.19	-0.13
	(0.21)	(0.35)	(0.26)	(0.22)	(0.36)	(0.33)
constant	0.71*	0.75	0.56*	-1.34***	-1.22	-0.94**
	(0.40)	(0.63)	(0.32)	(0.38)	(0.80)	(0.40)
observations	1,291	707	1,245	1,291	707	1,245

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

These results are mainly in line with the expectations in the theoretical model. Individuals whose knowledge exceeds a certain level show a higher propensity to be self-employed. It may be easier for them to set up businesses or enlarge ongoing commerce. They may switch from unemployment to self-employment if the expected income from working is high enough and exceeds their utility from supplying no labor. Similarly, they may switch from wage employment to self-employment as the expected returns in self-employment may sufficiently exceed those from wage employment to justify the change in job type.

For individuals with no education this opportunity does not seem to exist. According to the estimates in columns (3) and (6), they are not more likely to be self-employed or less likely to be in wage employment. However, the lack of an effect for men without education deviates from the expectation that these individuals are more likely to quit their jobs in favor of leisure. One possible reason is that remittances are not sufficient and that for most people it is not an alternative not to work. That is, if individuals quit their jobs they may only do so in favor of a different job (type). If individuals lack this possibility due to insufficient skills they may have to stay in the current job.

For highly educated men, living in the capital Dakar or other urban areas seems to decrease the chance of being self-employed. The reason for this may be a greater supply of wage employment possibilities in urban centers. A higher age is negatively related to self-employment, in contrast to the number of children, which shows a positive association. Correspondingly, these control variables are inversely related to wage employment (except living in Dakar, which shows a positive coefficient but is not significant). Men with no education are more likely to be in wage employment (column 6) and less likely to be self-employed (column 3) when their wealth increases.

Overall, the main estimations in Table 3.4 support the theory of differential labor supply responses to remittances. The following subsection considers the exogeneity assumptions for the instruments and provides a number of alternative estimations.

3.5.3 Exogeneity assumptions, robustness and effect sizes

As a first robustness test, I repeat the above estimations using Newey's (1987) two-step estimator. The reason for this choice is that it provides an overidentification test for the exogeneity of the instruments used. The instruments, however, have to be specified differently for this estimation. As noted above, the variables explaining the amount of remittances the migrant sends back are only observed for migration households. In this alternative specification I set the respective observations to 0 when dealing with non-migration households.[35]

Table 3.5 shows the results of this estimation. Here, remittances only have a significant impact on labor supply for highly educated males. However, they are now highly significant at the one percent level. This estimation suggests that highly educated individuals do indeed respond differently to remittances, while the effect on individuals with lower education levels is not robust.

The Wald test of exogeneity at the bottom of the columns shows that endogeneity seems to be a problem for the estimations in columns (1) and (4). As shown in Table 3.3, the migrant characteristics that I use as instruments are good predictors of the amount of remittances sent back to the family members in the country of origin and are therefore relevant. Concerning

[35] If I did not set these observations to 0 for non-migration households the corresponding observations would be missing and the analysis would be confined to migration households. Intuitively, considering these observations by setting them to 0 is equal to imagining that non-migration households in fact have a migrant. The latter, however, has values 0 for age, employment, duration of migration and African or non-African destination, which may only be true if there is no migrant in the household. This procedure ensures that as many observations as possible are retained for the analysis.

exogeneity, identification rests upon the assumption that there is no direct link between the instruments and labor decisions of non-migrant family members. Specifically, the mean age of a household's migrants or the duration of their migration should not be correlated with unobserved characteristics that predict employment of family members back home. The destination of the migrant (Africa or outside Africa) may well be shaped by the employment of a family member since families with more resources derived from labor income may be able to send a family member to a different destination compared to families without labor income. Controlling for wealth, however, the destination of a migrant should be exogenous to the labor decision of a family member. Finally, employment of a migrant as another instrument may be driven by unobserved family characteristics such as work ethics, which may also drive labor decisions of non-migrant family members. If the latter is the case, a test of overidentifiying restriction would produce significant results. I conduct the Amemiya-Lee-Newey Minimum χ^2 test (see Amemiya, 1978; Newey, 1987; Lee, 1992) of the null hypothesis that the instruments are valid. This hypothesis is not rejected for the relevant estimates in columns (1) and (4), with p-values of 0.56 and 0.24.[36] These results seem to suggest that the instruments may be considered to be valid.

[36] More precisely, the Amemiya-Lee-Newey Minimum χ^2 statistic is $\chi^2(4) = 3$ resulting in a p-value of 0.56 for column (1) and $\chi^2(4) = 5.53$ resulting in a p-value of 0.24 for column (4).

Table 3.5: Probit model using two-step Newey estimator and accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.05*** **	**0.02**	**-0.02**	**-0.06*** **	**-0.01**	**-0.02**
	(0.02)	**(0.03)**	**(0.02)**	**(0.02)**	**(0.04)**	**(0.03)**
age	-0.00	0.01*	0.01***	0.02***	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	-0.78***	-1.09***	-0.92***	0.35**	1.04***	0.42
	(0.15)	(0.23)	(0.22)	(0.16)	(0.28)	(0.26)
other urban areas	-0.42***	-0.43***	-0.71***	0.27*	0.41**	0.36**
	(0.13)	(0.16)	(0.12)	(0.14)	(0.20)	(0.16)
no. of children	0.02*	0.05***	0.03*	-0.01	-0.03	-0.04**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
wealth	-0.12***	-0.06	-0.17***	0.15***	0.03	0.12**
	(0.03)	(0.05)	(0.05)	(0.03)	(0.06)	(0.06)
inverse Mill's ratio	0.15	0.26**	0.06	-0.06	-0.13	0.06
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.13)
constant	0.29	0.47**	0.80***	-1.05***	-1.26***	-1.44***
	(0.18)	(0.24)	(0.19)	(0.19)	(0.27)	(0.23)
observations	1,289	705	1,240	1,289	705	1,240
Wald test of exogeneity	0.07	0.17	0.68	0.00	0.13	0.20

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 3.6: Probit model accounting for selection & endogeneity (first-stage OLS)

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.09****	**0.07**	**0.04**	**-0.11****	**-0.06**	**-0.08**
	(0.04)	**(0.08)**	**(0.07)**	**(0.04)**	**(0.07)**	**(0.07)**
age	-0.02**	-0.01	0.01	0.03***	0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
dakar	-0.93***	-1.23**	-0.52	0.57*	1.19*	0.09
	(0.33)	(0.51)	(0.42)	(0.31)	(0.64)	(0.52)
other urban areas	-0.78***	-0.25	-0.39	0.65**	0.28	0.24
	(0.28)	(0.43)	(0.28)	(0.26)	(0.57)	(0.35)
no. of children	0.04	0.10*	0.01	-0.04	-0.06	-0.04
	(0.03)	(0.05)	(0.03)	(0.03)	(0.05)	(0.03)
wealth	-0.04	0.03	-0.42***	0.03	-0.07	0.39***
	(0.09)	(0.14)	(0.12)	(0.08)	(0.17)	(0.15)
inverse Mill's ratio	0.52**	0.21	0.24	-0.38*	-0.02	-0.20
	(0.22)	(0.40)	(0.29)	(0.23)	(0.39)	(0.37)
constant	0.58	0.86	0.48	-1.14***	-1.34	-0.76
	(0.40)	(0.68)	(0.37)	(0.38)	(0.82)	(0.47)
observations	1,289	705	1,240	1,289	705	1,240
Wald test of exogeneity	0.03	0.47	0.27	0.01	0.08	0.11

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table 3.7: Simultaneous equation model accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.05*** **	**0.02**	**-0.02**	**-0.06*** **	**-0.01**	**-0.02**
	(0.02)	**(0.03)**	**(0.02)**	**(0.02)**	**(0.03)**	**(0.03)**
age	0.00	0.01**	0.01***	0.02***	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
dakar	-0.78***	-1.08***	-0.93***	0.35**	1.03***	0.42*
	(0.15)	(0.22)	(0.20)	(0.15)	(0.24)	(0.25)
other urban areas	-0.43***	-0.41***	-0.72***	0.27**	0.40**	0.36**
	(0.13)	(0.15)	(0.12)	(0.14)	(0.18)	(0.14)
no. of children	0.02*	0.05***	0.03*	-0.01	-0.03	-0.04**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
wealth	-0.12***	-0.06	-0.17***	0.15***	0.03	0.13**
	(0.03)	(0.05)	(0.05)	(0.03)	(0.06)	(0.06)
inverse Mill's ratio	0.15	0.26**	0.06	-0.06	-0.14	0.06
	(0.11)	(0.12)	(0.12)	(0.11)	(0.13)	(0.14)
constant	0.29	0.47**	0.80***	-1.06***	-1.27***	-1.44***
	(0.18)	(0.22)	(0.19)	(0.18)	(0.26)	(0.24)
observations	1,289	705	1,240	1,289	705	1,240

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 3.8: 2SLS model accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.03****	**0.02**	**0.01**	**-0.04****	**-0.01**	**-0.01**
	(0.02)	**(0.02)**	**(0.01)**	**(0.02)**	**(0.01)**	**(0.01)**
age	-0.01***	-0.00	0.00*	0.01***	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
dakar	-0.34***	-0.41***	-0.16	0.18*	0.34***	0.04
	(0.11)	(0.13)	(0.12)	(0.11)	(0.13)	(0.10)
other urban areas	-0.28***	-0.06	-0.05	0.21**	0.05	0.02
	(0.10)	(0.09)	(0.07)	(0.09)	(0.09)	(0.06)
no. of children	0.01	0.01**	0.00	-0.01	-0.01	-0.00
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)
wealth	-0.01	0.00	-0.08***	0.01	-0.01	0.06**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
inverse Mill's ratio	0.19**	0.08	0.03	-0.15*	-0.02	-0.02
	(0.08)	(0.10)	(0.04)	(0.08)	(0.08)	(0.03)
constant	0.71***	0.81***	0.74***	0.10	0.08	0.18***
	(0.13)	(0.13)	(0.07)	(0.12)	(0.13)	(0.07)
observations	1,289	705	1,240	1,289	705	1,240
R-squared	0.10	0.23	0.16	0.08	0.16	0.08

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Next, I estimate a version of the main specification using an ordinary least squares regression for remittances instead of a Tobit regression and include the instruments as specified in Newey's (1987) two-step estimator above. In this way I check the results for small deviations from the main specification and am provided with a simple way to compute marginal effects. The results for highly educated men shown in Table 3.6 are very similar. Remittances increase the chance of self-employment and decrease the probability of wage employment. In contrast, there is no effect for men with low levels of education for either job type, as was the case in the two-step estimator.

In another robustness check I consider the possibility that not only remittances may influence labor supply and occupational choice but also that the latter may influence the remittance-sending behavior.[37] A migrant abroad may be more likely to send back remittances if recipients are unemployed than if they have a job. Moreover, the amount of remittances may also be a function of the type of employment. It is possible that the self-employed need more money for their businesses or alternatively that individuals in wage employment may request more money if the wages are low. For this purpose I estimate a simultaneous equation model. The structural model may be written as (see Keshk, 2003):

$$R_i = Emp_i^* \alpha_{Emp} + E_i\, \alpha_E + (Emp_i^* * E_i)\alpha_{Emp_i^* * E} + X_i \alpha_X + \varepsilon_i \qquad (3.16)$$

$$Emp_i^* = R_i \beta_R + E_i\, \beta_E + (R_i * E_i)\beta_{R*E} + X_i \beta_X + \mu_i \qquad (3.17)$$

[37] The instrumental variable regressions applied in this section also account for endogeneity resulting from reverse causation. The simultaneous equation achieves the same and, in addition, explicitly models the reverse relationship.

[38] Note that for the purpose of illustration I include the interaction between remittances and education in the equations again. In the estimation, as seen so far, I split the data into three categories of education and estimate the parameters of the model separately for each category.

The methodology is based on an ordinary least squares and a probit estimation, where fitted values are computed and plugged into the respective equations. Since the values that are inserted are estimates, the standard errors are subsequently corrected (see Keshk, 2003, pp.159-162 for details of this methodology).

The results of these estimations are presented in Table 3.7. Remittances have a highly significant positive impact on the probability of being self-employed and a highly significant negative influence on wage employment for highly educated males. In the cases of those with a low level of education or no education there is no significant impact of remittances. These results corroborate the results of the estimations using Newey's (1987) two-step estimator in Table 3.5 and the results of the instrumental variable probit estimates in Table 3.6.

Finally, I consider a straightforward two-stage least squares procedure. The advantages of a non-linear probit model over a linear probability model are well known.[39] In the latter, however, no additional distributional assumptions have to be met, unlike is the case in the main estimation using the methodology of Rivers and Vuong (1988) where normality of μ_i is necessary (see Wooldrige, 2002, p.474). Table 3.8 shows the results for this alternative specification. The pattern corresponds to the preceding robustness checks: Highly educated males are more likely to be self-employed whereas they are less likely to be in wage employment when they receive remittances. Furthermore, men with low levels of education or with no education do not seem to respond to remittances in either direction.

To fully understand the meaning of these results we would need to find out if the coefficients of the variable *remittances per capita* are different from one another across the estimations for the three education levels. This is not an easy task as the coefficients are not

[39] The linear probability model may produce out-of-bound predictions (below 0 and above 1) and has built-in heteroscedasticity.

obtained within a single estimation. For a simple way of comparing the coefficients, I estimate the linear two-stage least squares model again, including interactions of education dummies with remittances. While this is not exactly equivalent to the main specification it is a closely related model where interactions can be included and their interpretation is straightforward. The instruments for this model are the instruments used so far and the interactions between these instruments and the respective education levels. The results of this model are shown in Table 3.9. Columns (1) and (2) use *no education* as the reference category. In column (1) *remittances* interacted with *low education* as well as *remittances* interacted with *high education* have positive signs and are significant at the 10% level, suggesting that individuals with some primary education or higher education are more likely to be self-employed when receiving remittances than individuals without education. Correspondingly, column (2) shows that, for the highly educated, wage-employment decreases in remittances in comparison with individuals without education. For a simple interpretation, columns (3) and (4) repeat the estimations using low education as the reference category to test if there are differences between low and highly educated men. The coefficients of the interaction terms of remittances with high levels of education are insignificant. Therefore, the increase in the likelihood of being self-employed for individuals with a low level of education does not seem to be different for the highly educated.

Table 3.9: Education interacted with remittances per capita

	(1) Self-employment	(2) Wage employment	(3) Self-employment	(4) Wage employment
remittances p.c.	**0.00**	**-0.01**	**0.03****	**-0.02**
	(0.01)	**(0.01)**	**(0.01)**	**(0.01)**
no education			**0.10****	**-0.07**
			(0.05)	**(0.04)**
remittances p.c. x no education			**-0.03***	**0.01**
			(0.02)	**(0.01)**
low education	**-0.10****	**0.07**		
	(0.05)	**(0.04)**		
remittances p.c. x low education	**0.03***	**-0.01**		
	(0.02)	**(0.01)**		
high education	**-0.23*****	**0.23*****	**-0.14****	**0.16*****
	(0.05)	**(0.04)**	**(0.06)**	**(0.06)**
remittances p.c. x high education	**0.03***	**-0.03****	**0.00**	**-0.02**
	(0.02)	**(0.01)**	**(0.02)**	**(0.02)**
age	-0.00	0.00***	-0.00	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	-0.26***	0.15**	-0.26***	0.15**
	(0.06)	(0.06)	(0.06)	(0.06)
other urban areas	-0.14***	0.11**	-0.14***	0.11**
	(0.05)	(0.04)	(0.05)	(0.04)
no. of children	0.01**	-0.01***	0.01**	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
wealth	-0.04**	0.03	-0.04**	0.03
	(0.02)	(0.02)	(0.02)	(0.02)
inverse Mill's ratio	0.08**	-0.05	0.08**	-0.05
	(0.04)	(0.03)	(0.04)	(0.03)
constant	0.81***	0.08	0.72***	0.15**
	(0.06)	(0.06)	(0.06)	(0.06)
observations	3,234	3,234	3,234	3,234
R-squared	0.26	0.18	0.26	0.18

Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights. In columns (1) and (2) the reference category for education is *no education*, while in columns (3) and (4) it is *low education*.

Overall, this suggests that there is a difference with respect to occupational decisions between individuals with no education and those with at least some education. The likelihood of self-employment for individuals with low or high levels of education appears to increase with remittances if compared to those with no education.

After the discussion of the five major specifications, I now turn to the issue that the instruments are only available for migrant households. I therefore run all five specifications shown above for a subset of the sample, encompassing migration households only (see Appendix E1). The results are less significant in general, which is likely to be caused by the lower numbers of observations. The results of this robustness check concerning the two-step Newey estimator and the simultaneous equations regressions are in line with the results obtained earlier.[40]

Furthermore, the decision to take up employment and what type to choose may depend on the specific regional situation of the job market. In areas with more companies and shops the opportunity for wage employment may be larger than in others. Moreover, for the selection equation to be valid, migration networks need to be exogenous of labor market outcomes. However, if a district has a large share of migrants this may increase wages (see Jadotte, 2009, p.5) making wage employment relatively more attractive. In order to alleviate these concerns, I include dummies for 29 Senegalese *départements* to control for regional labor market particularities and other region-specific effects (see Appendix E2). The results from the five major specifications including these additional variables corroborate the main results for highly educated men.

[40] The results from the main estimation using Rivers and Vuong's (1988) methodology (Table E1.1) suggest, however, that instead of the highly skilled those with low skill levels are significantly more likely to be self-employed when they receive remittances. This could be an indication of an inverted u-shaped curve of the effect, with no impact for very highly educated individuals. This, perhaps, indicates that for this high level of education wages are more elastic with respect to human capital than income from self-employment, as discussed as an option in the theoretical part of this chapter.

As a further set of robustness checks I test a number of alternative measurements of the explanatory variable remittances. So far, I have used a variable consisting of 11 categories, which are the ten deciles for positive amounts of remittances in addition to zero as its own category. I estimate the five major specifications measuring the explanatory variable simply as remittances *per capita* and as logarithm to include non-linearity, as the marginal utility of additional remittances may be decreasing. The results of these alternative specifications are also in line with those of the main specifications (see Appendices E3 and E4).

Furthermore, I am concerned that it might not be remittances that are driving the effects but rather the fact that a migrant household may diversify its risks since a family member abroad could potentially absorb losses from an unsuccessful business (see Azam and Gubert, 2005).[41] For this reason, I run the main specification again using a dummy defined as 1 if it is a migration household and 0 otherwise. I instrument this dummy using the measure for migration networks. The coefficients are generally insignificant except for a significant negative effect on the wage employment of men with low levels of education (see Appendix E5). Hence, the main results for highly educated men do not seem to be driven by household diversification strategies.

Who are the individuals who become self-employed or leave wage employment as a response to remittances? The analysis, so far, cannot answer the question of whether waged individuals change to self-employment or if it is the unemployed who chose to become self-employed. To answer this question I run the five major specifications using employment in general (irrespective of self-employment or wage employment; see Appendix E.6) as a binary dependent variable. The results show that remittances *per capita* is generally an insignificant

[41] Alternatively or in addition there may be a disruptive effect if non-migrant family members have to replace labor activities a migrant formerly carried out (e.g. Amuedo-Dorantes and Pozo, 2006). This effect is described in more detail in subsection 3.5.4 for women.

predictor for employment for any education level, suggesting that it is rather a change in job type than a change in the employment status that drives the results for the highly educated.

Finally, I check the robustness of these results by changing the measurement of the dependent variables. Self-employment and wage employment – as detailed in the data description – were defined as 0 if an individual is unemployed or taking care of the household. This measurement takes the point of view that those taking care of the household may want to be employed as well but as they cannot find a job opportunity they stay at home instead. However, these individuals may be taking care of the household because they wish to do so and not be actively searching for a job or willing to accept a job offer. That is, they should not be counted as unemployed. I change the measurement of the self- and wage employment variables to account for this and run all 25 estimations again.[42] The results qualitatively corroborate the prior findings of an increase in self-employment and decrease in wage employment as a response to receiving remittances for highly educated individuals.

Based on the main estimation and the various robustness checks we may conclude that Senegalese men receiving remittances from former household members who have migrated do indeed respond to remittances by changing their occupational choice. In line with the arguments derived in the theoretical framework I find that more highly educated men are more likely to be self-employed as a result of remittances flows. In contrast, individuals with no education do not show responses in their labor activity when they receive remittances.

As indicated above, I will compute the average marginal effects from the instrumental variable probit estimation. For ease of interpretation, however, I do not interpret the specification using remittances measured in deciles but rather the estimation using the actual amount of

[42] These 25 estimations include the five specifications shown in the main text, the same estimations for the subset of migration households only, variations including regional dummies and alternative measurements of remittances as actual amounts transferred and logarithmized amounts transferred. These estimations are not shown but are available from the author upon request.

remittances received. The results suggest than an increase in remittances of one unit (100,000 West-African Francs or about 219 US Dollars in 2009)[43] enhances the chances of self-employment of highly skilled men by about 12 percentage points or – considering the mean value of self-employment for the highly educated – about 24 percent. An increase of the same size reduces the likelihood of wage employment by about 12 percentage points or about 32 percent. [44] As the sizes of these effects are considerable, the differential occupational choice of individuals in response to remittances depending on their human capital seems to be an important factor in explaining the composition of the Senegalese labor market.

3.5.4 Estimation results for female recipients

Turning to the case of women we may expect results that differ from those of men, as the general literature review has shown in section 3.1. The dynamics regarding the relationship between remittances, labor supply and education may differ for women due to their role in Senegalese society. For example, if men are traditionally responsible for earning (most of) the household income, then women may possibly respond weakly to the receipt of remittances (see Rodriguez and Tiongson, 2001, pp.712-713). They may not have had a job in the first place and therefore there would be no reduction in labor supply. If they are employed, receiving money from household members who have migrated may induce them to supply less labor, as Lokshin and Glinskaya (2009) argue in the case of Nepalese women. On the other hand, there may be a disruptive effect: If a husband migrates, his wife may have to take over tasks formerly carried out by the man (see Hanson, 2007, p.74; Mendola and Carletto, 2009, p.4; Amuedo-Dorantes

[43] Exchange rate on 31 December 2009 from Bloomberg (2014).
[44] The mean values of highly educated men are 51 percent for self-employment and 37 percent for wage employment.

and Pozo, 2006, p.222). She may have to find an employment or – from a different point of view – she may be empowered in her decision-making and choose to find employment (see Ratha et al., 2011, p.31; Deshingkar and Grimm, 2005, p.39). Since these opposing effects are both conceivable, it is ultimately an empirical question as to what effect prevails. Regarding job type, the theoretical framework used so far could explain occupational choice behavior for women as well. More education may increase the probability of choosing self-employment in response to remittances if its relative utility is higher than that of wage employment.

The results of the main estimation for women and the four major robustness checks carried out throughout this chapter are shown in Appendix F1. They suggest that there is no effect of remittances on self-employment or on wage employment, irrespective of the level of education. Remittances do not seem to play a role for female labor supply or occupational choice. We may thus conjecture that it is rather a disruptive effect that plays a role for Senegalese women, as indeed about 78 percent of the migrants in our data set are men (see summary statistics in Table 3.1). To see if there is indeed a disruptive effect, Appendix F2 shows the results of an estimation including migration *per se* instead of remittances as explanatory variable. The results are generally insignificant except for women without education and self-employment. This possibly suggests that uneducated women are empowered by the migration decision of a household member and take up self-employment in a situation where wage employment is scarce (only 2 percent of uneducated women are wage employed based on this sample, versus 40 percent who are self-employed). The employment situation of more educated women is better for wage employment and may therefore not show a disruptive effect in the estimations.

3.6 Conclusions

The amount of remittances to Sub-Saharan African countries as a share of GDP is considerable and is likely to have an effect on labor market outcomes. In Senegal, this share reached about 10 percent in 2011, with an upward trend (UNCTAD, 2013; World Bank, 2013). The results of past studies on the effect of remittances on labor supply are ambiguous. The standard argument, in a neo-classical sense, is that reservation wages increase with non-labor income. In this study, I expand this theory by introducing human capital-related considerations. I argue that in the case of those with low levels of education labor supply responses to remittances may be negative. For more educated individuals, however, there may be an incentive to take up employment. Specifically, more highly educated individuals may have the basic knowledge necessary for opening up a small business or investing more productively in agricultural activities. I develop a formal theoretical framework that encompasses these two lines of argument and combines them with the literature on occupational choice in order to show how the level of education may alter the predictions regarding labor supply and occupational choice when individuals receive remittances.

Consequently, I examine the impact of remittances on labor supply and occupational choice of household members left behind for different levels of education. Using the two-step estimator by Rivers and Vuong (1988) I find evidence that men receiving remittances are less likely to be in wage employment but more likely to be in self-employment if they are more highly educated. There is also some evidence that this effect may be non-linear, as highly educated men may also be offered well-paid wage jobs that seem more attractive than setting up an own business. In contrast, women and less educated men generally do not show significant effects in either direction. The results for highly educated men are robust to a number of

alternative specifications using Newey's (1987) two-step estimator, simultaneous equations and two-stage least squares. The sizes of these effects are considerable and this finding may prove useful in understanding the dynamics of the labor markets in Sub-Saharan African economies. If labor supply responses to non-labor income are brought forth by the ability to build up a self-employment business rather than by work preferences, then this has important implications. Against the backdrop of low education levels and low school enrolment rates in Sub-Saharan Africa, positive labor supply responses from money transfers may not be expected for large parts of the society. In contrast, additional efforts by governments to increase education levels may be rewarded by lower unemployment rates and more economic activity.

The findings of this chapter offer a number of promising suggestions for future research in this area to increase our understanding of labor supply and occupational choice behavior of non-migrant family members in sending countries. First, the impact of remittances on economic activity may be limited if the level of education is too low for people to profitably use these additional financial means. Therefore, the differential effect of human capital on employment and job creation should be further studied. A natural starting point would be the analysis of countries with higher levels of education in general.

Second, it seems important to distinguish between rural and urban areas more specifically in future research to find out if human capital is as important a moderator in the countryside as in cities or if there are varying effects. However, this differentiated analysis was not possible in this chapter due to the limited number of observations. Third, I did not find any effects for women. However, this is likely to be the outcome in a society where men are traditionally responsible for work outside the home. Taking this one step further, this means that if women are empowered in such societies they are likely to face the same considerations in relation to labor supply and occupational choice that men do. Human capital may then also play an important role in their

labor market decisions in response to remittances. Finally, almost all of the literature in this field uses cross-sectional survey data to establish the effects remittances have on labor supply and occupational choice. Information on the same non-migrant family members of migration households and on the same individuals from non-migration control households for several time periods would greatly enhance our understanding of the prevailing dynamics.

Appendix E: Robustness checks (men)

E1 Subset of migration households

Table E1.1: Probit model corrected for selection & endogeneity (first-stage Tobit)

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.00**	**0.22****	**0.03**	**-0.02**	**-0.26****	**-0.08**
	(0.04)	**(0.10)**	**(0.09)**	**(0.05)**	**(0.10)**	**(0.10)**
age	-0.01	-0.02	0.00	0.03***	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dakar	-0.69*	-1.56***	-0.43	0.10	1.60**	-0.61
	(0.39)	(0.57)	(0.64)	(0.40)	(0.72)	(0.79)
other urban areas	-0.40	-0.84**	-0.28	0.15	0.83	-0.18
	(0.34)	(0.42)	(0.34)	(0.34)	(0.58)	(0.44)
no. of children	0.07**	-0.00	0.03	-0.06*	0.04	-0.04
	(0.03)	(0.05)	(0.05)	(0.03)	(0.06)	(0.04)
wealth	0.05	0.05	-0.35**	-0.04	-0.01	0.46*
	(0.11)	(0.18)	(0.17)	(0.11)	(0.23)	(0.24)
residual	-0.05	-0.13	-0.09	0.09*	0.10	0.14
	(0.05)	(0.08)	(0.09)	(0.05)	(0.10)	(0.11)
inverse Mill's ratio	0.11	0.47	0.22	-0.04	-0.09	0.07
	(0.27)	(0.54)	(0.45)	(0.28)	(0.68)	(0.61)
constant	0.71	1.14	0.60	-1.24**	-1.60	-1.16*
	(0.46)	(0.76)	(0.51)	(0.48)	(1.03)	(0.68)
observations	774	418	755	774	418	755

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table E1.2: Probit model using two-step Newey estimator and accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.05***	**0.09**	**0.02**	**-0.08*****	**0.03**	**-0.06**
	(0.03)	**(0.06)**	**(0.04)**	**(0.03)**	**(0.07)**	**(0.05)**
age	-0.00	0.01	0.01***	0.02***	-0.00	-0.00
	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
Dakar	-0.88***	-1.07***	-1.04***	0.48**	0.68*	0.34
	(0.20)	(0.31)	(0.29)	(0.21)	(0.37)	(0.37)
other urban areas	-0.39**	-0.48**	-0.80***	0.36*	0.42	0.21
	(0.17)	(0.21)	(0.15)	(0.19)	(0.26)	(0.20)
no. of children	0.02	0.02	0.03*	-0.00	-0.00	-0.04*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
wealth	-0.08*	-0.07	-0.17***	0.11**	0.02	0.14*
	(0.05)	(0.07)	(0.06)	(0.05)	(0.09)	(0.08)
inverse Mill's ratio	0.18	0.15	-0.02	-0.07	0.35	0.30
	(0.14)	(0.23)	(0.18)	(0.14)	(0.26)	(0.22)
constant	0.29	0.43	0.62**	-1.13***	-1.87***	-1.35***
	(0.26)	(0.41)	(0.27)	(0.27)	(0.47)	(0.34)
observations	774	418	755	774	418	755
Wald test of exogeneity	0.09	0.67	0.14	0.00	0.14	0.07

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table E1.3: Probit model accounting for selection & endogeneity (first-stage OLS)

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.04**	**0.19**	**0.04**	**-0.07**	**-0.22**	**-0.11**
	(0.07)	**(0.14)**	**(0.12)**	**(0.06)**	**(0.15)**	**(0.12)**
age	-0.01	-0.02	0.01	0.02***	0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dakar	-0.77*	-1.57***	-0.49	0.25	1.65**	-0.50
	(0.41)	(0.57)	(0.63)	(0.41)	(0.70)	(0.74)
other urban areas	-0.49	-0.81*	-0.24	0.29	0.81	-0.24
	(0.35)	(0.45)	(0.34)	(0.35)	(0.61)	(0.44)
no. of children	0.06*	0.01	0.04	-0.05	0.02	-0.05
	(0.03)	(0.05)	(0.04)	(0.03)	(0.06)	(0.03)
wealth	0.05	0.06	-0.34**	-0.04	-0.03	0.45**
	(0.12)	(0.19)	(0.16)	(0.12)	(0.23)	(0.22)
inverse Mill's ratio	0.26	0.41	0.28	-0.26	-0.02	-0.06
	(0.32)	(0.60)	(0.46)	(0.29)	(0.76)	(0.59)
constant	0.51	1.21	0.34	-0.89*	-1.73	-0.61
	(0.52)	(0.96)	(0.77)	(0.52)	(1.21)	(0.94)
observations	774	418	755	774	418	755
Wald test of exogeneity	0.25	0.56	0.39	0.04	0.81	0.12

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table E1.4: Simultaneous equation model accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.05***	**0.09***	**0.02**	**-0.08*****	**0.03**	**-0.06**
	(0.03)	**(0.05)**	**(0.04)**	**(0.03)**	**(0.06)**	**(0.05)**
age	0.00	0.01	0.01***	0.02***	0.00	0.00
	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
Dakar	-0.88***	-1.05***	-1.05***	0.48**	0.68*	0.38
	(0.19)	(0.29)	(0.28)	(0.20)	(0.35)	(0.35)
other urban areas	-0.39**	-0.46**	-0.80***	0.36**	0.41*	0.24
	(0.16)	(0.19)	(0.15)	(0.18)	(0.23)	(0.19)
no. of children	0.02	0.02	0.03	0.00	0.00	-0.04
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
wealth	-0.08*	-0.08	-0.16***	0.11**	0.03	0.14*
	(0.05)	(0.07)	(0.06)	(0.05)	(0.09)	(0.08)
inverse Mill's ratio	0.18	0.16	-0.03	-0.07	0.34	0.30
	(0.14)	(0.22)	(0.17)	(0.14)	(0.25)	(0.21)
constant	0.29	0.42	0.63**	-1.14***	-1.87***	-1.38***
	(0.25)	(0.38)	(0.28)	(0.27)	(0.47)	(0.35)
observations	774	418	755	774	418	755

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table E1.5: 2SLS model accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.01**	**0.05**	**0.01**	**-0.03**	**-0.04**	**-0.01**
	(0.02)	**(0.03)**	**(0.02)**	**(0.02)**	**(0.03)**	**(0.01)**
age	-0.00*	-0.00	0.00	0.01***	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	-0.29**	-0.42***	-0.16	0.08	0.34***	-0.06
	(0.14)	(0.14)	(0.19)	(0.14)	(0.13)	(0.14)
other urban areas	-0.17	-0.16*	-0.02	0.10	0.11	-0.06
	(0.12)	(0.10)	(0.08)	(0.11)	(0.09)	(0.08)
no. of children	0.02**	0.00	0.01	-0.01*	0.00	-0.01**
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)
wealth	0.02	0.00	-0.07*	-0.01	0.01	0.06
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
inverse Mill's ratio	0.10	0.11	0.03	-0.10	0.00	-0.01
	(0.11)	(0.13)	(0.05)	(0.10)	(0.12)	(0.04)
constant	0.69***	0.85***	0.71***	0.17	0.06	0.20*
	(0.17)	(0.18)	(0.14)	(0.17)	(0.16)	(0.12)
observations	774	418	755	774	418	755
R-squared	0.06	0.16	0.12	0.02	0.18	0.04

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

E2 Including Senegalese *départements*

Table E2.1: Probit model accounting for selection & endogeneity (first-stage Tobit) – including regional dummies

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.07***	**0.13***	**0.07**	**-0.08****	**-0.13**	**-0.09**
	(0.04)	**(0.07)**	**(0.06)**	**(0.04)**	**(0.08)**	**(0.07)**
age	-0.02**	-0.01	0.02	0.03***	0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dakar	-0.31	1.91**	0.55	1.09*	-2.25***	-0.14
	(1.08)	(0.90)	(0.67)	(0.64)	(0.84)	(4.80)
other urban areas	-0.73*	-0.97**	-1.39***	0.47	1.53***	1.14***
	(0.40)	(0.48)	(0.30)	(0.42)	(0.52)	(0.36)
no. of children	0.04	0.08	-0.03	-0.05	-0.01	0.01
	(0.03)	(0.05)	(0.03)	(0.03)	(0.05)	(0.03)
wealth	0.05	0.15	-0.08	-0.02	-0.31	0.15
	(0.10)	(0.18)	(0.17)	(0.10)	(0.19)	(0.20)
Residual	-0.09*	-0.08	-0.11	0.14***	0.05	0.12
	(0.05)	(0.08)	(0.09)	(0.05)	(0.09)	(0.10)
inverse Mill's ratio	0.46*	0.72*	-0.15	-0.24	-0.69	0.34
	(0.26)	(0.43)	(0.35)	(0.26)	(0.49)	(0.39)
constant	0.63	0.65	2.83***	-1.01	-1.74	-2.35*
	(0.69)	(0.67)	(0.49)	(0.70)	(1.79)	(1.20)
départements dummies	yes	yes	yes	yes	yes	yes
observations	1,288	643	1,098	1,278	568	967

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table E2.2: Probit model using two-step Newey estimator and accounting for selection & endogeneity – including regional dummies

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.05****	**0.03**	**-0.03**	**-0.07*****	**-0.03**	**-0.01**
	(0.02)	**(0.03)**	**(0.03)**	**(0.02)**	**(0.04)**	**(0.04)**
age	-0.00	0.01***	0.01***	0.02***	-0.01	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	-0.50	1.59	-0.24	0.38	-1.75	1.28
	(0.50)	(4.01)	(4.03)	(0.63)	(4.01)	(5.69)
other urban areas	-0.08	-0.62***	-0.93***	0.01	1.07***	0.45**
	(0.19)	(0.23)	(0.17)	(0.20)	(0.27)	(0.22)
no. of children	0.03*	0.06***	0.01	-0.02	-0.04	-0.01
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
wealth	-0.11***	-0.03	-0.06	0.13***	-0.04	-0.08
	(0.04)	(0.07)	(0.06)	(0.04)	(0.08)	(0.08)
inverse Mill's ratio	0.16	0.45***	0.15	-0.11	-0.39***	-0.04
	(0.13)	(0.12)	(0.14)	(0.13)	(0.12)	(0.16)
constant	-0.51	-0.54	1.04***	-0.08	-0.99**	-1.28**
	(0.43)	(0.38)	(0.40)	(0.43)	(0.50)	(0.62)
départements dummies	yes	yes	yes	yes	yes	yes
observations	1,286	641	1,093	1,276	566	962
Wald test of exogeneity	0.16	0.39	0.76	0.00	0.61	0.15

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table E2.3: Probit model accounting for selection & endogeneity (first-stage OLS) – including regional dummies

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.08***	**0.05**	**n/a**	**-0.10****	**-0.06**	**n/a**
	(0.04)	**(0.08)**		**(0.04)**	**(0.09)**	
age	-0.02**	-0.01	n/a	0.02***	0.00	n/a
	(0.01)	(0.01)		(0.01)	(0.01)	
Dakar	-0.31	1.75*	n/a	1.06*	-2.13	n/a
	(1.05)	(0.95)		(0.61)	(5.74)	
other urban areas	-0.67*	-1.05**	n/a	0.38	1.65***	n/a
	(0.39)	(0.47)		(0.40)	(0.52)	
no. of children	0.04	0.10*	n/a	-0.04	-0.02	n/a
	(0.03)	(0.05)		(0.03)	(0.05)	
wealth	0.06	0.18	n/a	-0.03	-0.32*	n/a
	(0.11)	(0.18)		(0.11)	(0.18)	
inverse Mill's ratio	0.58**	0.57	n/a	-0.40	-0.58	n/a
	(0.28)	(0.42)		(0.27)	(0.53)	
constant	0.34	0.70	n/a	-0.60	-1.75	n/a
	(0.69)	(0.64)		(0.68)	(1.72)	
départements dummies	yes	yes	yes	yes	yes	yes
observations	1,286	641	n/a	1,276	566	n/a
Wald test of exogeneity	0.05	0.15	n/a	0.01	0.19	n/a

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table E2.4: Simultaneous equation model accounting for selection & endogeneity – including regional dummies

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.04****	**0.02**	**-0.03**	**-0.07*****	**-0.02**	**-0.02**
	(0.02)	**(0.03)**	**(0.03)**	**(0.02)**	**(0.04)**	**(0.03)**
age	0.00	0.01***	0.01***	0.02***	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Dakar	-0.50	-0.19	-0.26	0.38	-1.66**	2.16***
	(0.45)	(0.52)	(0.82)	(0.48)	(0.82)	(0.57)
other urban areas	-0.07	-0.50**	-0.93***	0.01	0.87***	0.43**
	(0.20)	(0.21)	(0.16)	(0.21)	(0.28)	(0.22)
no. of children	0.03*	0.06***	0.01	-0.02	-0.03	-0.02
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
wealth	-0.11***	-0.05	-0.06	0.13***	-0.05	-0.08
	(0.04)	(0.06)	(0.06)	(0.04)	(0.07)	(0.08)
inverse Mill's ratio	0.13	0.39***	0.14	-0.11	-0.37**	-0.01
	(0.12)	(0.14)	(0.14)	(0.12)	(0.16)	(0.17)
constant	0.08	1.21***	2.45***	-1.68***	-2.48***	-3.19***
	(0.66)	(0.42)	(0.47)	(0.50)	(0.48)	(0.57)
départements dummies	yes	yes	yes	yes	yes	yes
observations	1,289	705	1,240	1,289	705	1,240

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table E2.5: 2SLS model accounting for selection & endogeneity – including regional dummies

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.03****	**0.01**	**0.01**	**-0.04*****	**0.00**	**-0.01****
	(0.01)	**(0.01)**	**(0.01)**	**(0.01)**	**(0.01)**	**(0.00)**
age	-0.01***	-0.00*	0.00**	0.01***	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	-0.10	0.54***	0.10	0.17**	-0.70***	-0.01
	(0.18)	(0.08)	(0.17)	(0.07)	(0.12)	(0.16)
other urban areas	-0.22***	-0.18***	-0.19***	0.10	0.20***	0.09*
	(0.08)	(0.07)	(0.06)	(0.08)	(0.06)	(0.05)
no. of children	0.01	0.01**	-0.00	-0.01	0.00	0.00
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
wealth	0.02	0.04	-0.02	-0.01	-0.06**	0.02
	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.02)
inverse Mill's ratio	0.20**	0.14*	-0.03	-0.14*	-0.08	0.03
	(0.09)	(0.08)	(0.04)	(0.08)	(0.08)	(0.03)
constant	0.74***	0.76***	0.73***	-0.08	0.02	0.27
	(0.14)	(0.11)	(0.18)	(0.12)	(0.10)	(0.17)
départements dummies	yes	yes	yes	yes	yes	yes
observations	1,289	705	1,240	1,289	705	1,240
R-squared	0.16	0.42	0.30	0.13	0.38	0.20

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

E3 Remittances in actual units

Table E3.1: Probit model accounting for selection & endogeneity (first-stage Tobit)

	Self-employed			Wage employed		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.17**	**0.42**	**0.19**	**-0.20***	**-0.55****	**-0.18**
	(0.10)	**(0.31)**	**(0.19)**	**(0.10)**	**(0.28)**	**(0.27)**
age	-0.02**	-0.01	0.01	0.03***	0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dakar	-0.79**	-1.03**	-0.37	0.41	1.02	-0.02
	(0.34)	(0.52)	(0.44)	(0.32)	(0.65)	(0.55)
other urban areas	-0.69**	-0.15	-0.34	0.55**	0.20	0.23
	(0.29)	(0.42)	(0.29)	(0.27)	(0.55)	(0.35)
no. of children	0.05**	0.09*	0.01	-0.05**	-0.05	-0.04
	(0.03)	(0.05)	(0.03)	(0.03)	(0.06)	(0.03)
wealth	-0.05	-0.06	-0.48***	0.05	0.03	0.43***
	(0.09)	(0.15)	(0.14)	(0.09)	(0.17)	(0.16)
residual	-0.20*	-0.36	-0.21	0.26**	0.32	0.23
	(0.12)	(0.22)	(0.20)	(0.11)	(0.25)	(0.19)
inverse Mill's ratio	0.32	0.19	0.20	-0.14	-0.08	-0.08
	(0.20)	(0.35)	(0.27)	(0.21)	(0.36)	(0.33)
constant	0.77*	0.75	0.48	-1.40***	-1.20	-0.94**
	(0.40)	(0.59)	(0.30)	(0.38)	(0.75)	(0.37)
observations	1,291	707	1,245	1,291	707	1,245

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table E3.2: Probit model using two-step Newey estimator and accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.16*** **	**0.08**	**-0.08**	**-0.21*** **	**0.02**	**-0.08**
	(0.06)	**(0.12)**	**(0.08)**	**(0.06)**	**(0.14)**	**(0.11)**
age	-0.00	0.01*	0.01***	0.02***	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	-0.76***	-1.05***	-0.95***	0.32**	1.03***	0.38
	(0.15)	(0.23)	(0.22)	(0.16)	(0.28)	(0.27)
other urban areas	-0.45***	-0.41**	-0.71***	0.30**	0.40**	0.36**
	(0.13)	(0.16)	(0.12)	(0.14)	(0.20)	(0.16)
no. of children	0.03*	0.05***	0.03*	-0.02	-0.03	-0.04**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
wealth	-0.14***	-0.07	-0.16***	0.17***	0.03	0.13**
	(0.04)	(0.05)	(0.05)	(0.03)	(0.07)	(0.07)
inverse Mill's ratio	0.15	0.25**	0.08	-0.05	-0.12	0.07
	(0.11)	(0.10)	(0.11)	(0.11)	(0.11)	(0.12)
constant	0.33*	0.46*	0.79***	-1.11***	-1.30***	-1.42***
	(0.17)	(0.24)	(0.19)	(0.18)	(0.27)	(0.22)
observations	1,289	705	1,240	1,289	705	1,240
Wald test of exogeneity	0.02	0.99	0.32	0.00	0.81	0.25

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table E3.3: Probit model accounting for selection & endogeneity (first-stage OLS)

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.34****	**0.09**	**n/a**	**-0.36****	**-0.04**	**n/a**
	(0.15)	**(0.47)**		**(0.14)**	**(0.38)**	
age	-0.02**	-0.01	n/a	0.02***	0.01	n/a
	(0.01)	(0.01)		(0.01)	(0.01)	
Dakar	-0.73**	-1.19**	n/a	0.38	1.18*	n/a
	(0.32)	(0.50)		(0.29)	(0.61)	
other urban areas	-0.65**	-0.23	n/a	0.51**	0.29	n/a
	(0.27)	(0.43)		(0.24)	(0.56)	
no. of children	0.04*	0.10**	n/a	-0.04*	-0.06	n/a
	(0.03)	(0.05)		(0.03)	(0.05)	
wealth	-0.08	0.03	n/a	0.08	-0.09	n/a
	(0.09)	(0.15)		(0.08)	(0.18)	
inverse Mill's ratio	0.50**	0.10	n/a	-0.35*	0.11	n/a
	(0.20)	(0.43)		(0.20)	(0.40)	
constant	0.45	0.97	n/a	-0.96**	-1.48*	n/a
	(0.42)	(0.74)		(0.41)	(0.83)	
observations	1,289	705	n/a	1,289	705	n/a
Wald test of exogeneity	0.02	0.69	n/a	0.01	0.14	n/a

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table E3.4: Simultaneous equation model accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.16*** **	**0.08**	**-0.08**	**-0.21*** **	**0.02**	**-0.10**
	(0.06)	**(0.12)**	**(0.07)**	**(0.06)**	**(0.13)**	**(0.10)**
age	0.00	0.01**	0.01***	0.02***	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	-0.76***	-1.05***	-0.95***	0.32**	1.03***	0.38
	(0.15)	(0.22)	(0.21)	(0.15)	(0.24)	(0.25)
other urban areas	-0.45***	-0.40***	-0.72***	0.30**	0.40**	0.36**
	(0.13)	(0.15)	(0.12)	(0.14)	(0.18)	(0.14)
no. of children	0.03**	0.05***	0.03*	-0.02	-0.03	-0.04**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
wealth	-0.14***	-0.07	-0.16***	0.17***	0.03	0.14**
	(0.03)	(0.05)	(0.05)	(0.03)	(0.06)	(0.06)
inverse Mill's ratio	0.14	0.26**	0.08	-0.05	-0.12	0.08
	(0.10)	(0.11)	(0.11)	(0.11)	(0.12)	(0.13)
constant	0.33*	0.46**	0.80***	-1.12***	-1.31***	-1.43***
	(0.17)	(0.23)	(0.19)	(0.18)	(0.27)	(0.23)
observations	1,289	705	1,240	1,289	705	1,240

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table E3.5: 2SLS model accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.13****	**0.03**	**0.00**	**-0.15****	**0.02**	**-0.02**
	(0.06)	**(0.10)**	**(0.05)**	**(0.06)**	**(0.08)**	**(0.03)**
age	-0.01***	-0.00	0.00*	0.01***	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	-0.29**	-0.40***	-0.16	0.12	0.34***	0.02
	(0.12)	(0.13)	(0.12)	(0.11)	(0.13)	(0.10)
other urban areas	-0.25***	-0.05	-0.05	0.18**	0.06	0.00
	(0.10)	(0.10)	(0.07)	(0.09)	(0.10)	(0.06)
no. of children	0.02*	0.02**	0.00	-0.02*	-0.01*	-0.00*
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)
wealth	-0.03	0.00	-0.08**	0.03	-0.02	0.06**
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
inverse Mill's ratio	0.19**	0.05	0.01	-0.14*	0.01	-0.00
	(0.08)	(0.10)	(0.04)	(0.09)	(0.08)	(0.03)
constant	0.68***	0.84***	0.76***	0.13	0.05	0.18**
	(0.14)	(0.14)	(0.08)	(0.13)	(0.14)	(0.07)
observations	1,289	705	1,240	1,289	705	1,240
R-squared	0.02	0.22	0.16	-	0.15	0.07

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

E4 Logarithm of remittances

Table E4.1: Probit model accounting for selection & endogeneity (first-stage Tobit)

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.55****	**1.02***	**0.44**	**-0.62****	**-1.21****	**-0.48**
	(0.27)	**(0.62)**	**(0.52)**	**(0.27)**	**(0.56)**	**(0.59)**
age	-0.02**	-0.01	0.01	0.03***	0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dakar	-0.81**	-1.13**	-0.43	0.42	1.14*	0.02
	(0.33)	(0.52)	(0.44)	(0.31)	(0.66)	(0.55)
other urban areas	-0.69**	-0.20	-0.38	0.54**	0.26	0.25
	(0.29)	(0.42)	(0.29)	(0.27)	(0.56)	(0.36)
no. of children	0.05*	0.08	0.01	-0.05*	-0.04	-0.04
	(0.03)	(0.06)	(0.03)	(0.03)	(0.06)	(0.03)
wealth	-0.06	-0.03	-0.46***	0.05	-0.01	0.42***
	(0.09)	(0.14)	(0.13)	(0.09)	(0.17)	(0.16)
residual	-0.68**	-0.73	-0.73	0.91***	0.46	0.78
	(0.34)	(0.57)	(0.60)	(0.32)	(0.64)	(0.62)
inverse Mill's ratio	0.38*	0.27	0.22	-0.19	-0.16	-0.10
	(0.21)	(0.35)	(0.26)	(0.21)	(0.36)	(0.33)
constant	0.71*	0.74	0.54*	-1.34***	-1.20	-0.96**
	(0.40)	(0.61)	(0.31)	(0.38)	(0.78)	(0.40)
observations	1,291	707	1,245	1,291	707	1,245

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table E4.2: Probit model using two-step Newey estimator and accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.36*** **	**0.16**	**-0.20**	**-0.48*** **	**-0.02**	**-0.16**
	(0.13)	**(0.24)**	**(0.19)**	**(0.14)**	**(0.29)**	**(0.26)**
age	-0.00	0.01*	0.01***	0.02***	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	-0.77***	-1.07***	-0.93***	0.34**	1.03***	0.40
	(0.15)	(0.23)	(0.22)	(0.16)	(0.28)	(0.26)
other urban areas	-0.44***	-0.42***	-0.71***	0.29**	0.40**	0.35**
	(0.13)	(0.16)	(0.12)	(0.14)	(0.20)	(0.16)
no. of children	0.02*	0.05***	0.03*	-0.01	-0.03	-0.04**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
wealth	-0.13***	-0.06	-0.17***	0.16***	0.03	0.13**
	(0.03)	(0.05)	(0.05)	(0.03)	(0.06)	(0.06)
inverse Mill's ratio	0.15	0.26**	0.07	-0.06	-0.12	0.06
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.12)
constant	0.31*	0.47**	0.80***	-1.08***	-1.28***	-1.42***
	(0.18)	(0.24)	(0.19)	(0.19)	(0.27)	(0.23)
observations	1,289	705	1,240	1,289	705	1,240
Wald test of exogeneity	0.05	0.50	0.93	0.00	0.42	0.15

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table E4.3: Probit model accounting for selection & endogeneity (first-stage OLS)

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.76****	**0.38**	**0.24**	**-0.84****	**-0.41**	**-0.57**
	(0.35)	**(0.84)**	**(0.56)**	**(0.34)**	**(0.61)**	**(0.65)**
age	-0.02**	-0.01	0.01	0.03***	0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dakar	-0.86***	-1.20**	-0.49	0.49	1.20*	0.01
	(0.32)	(0.50)	(0.44)	(0.30)	(0.63)	(0.55)
other urban areas	-0.73***	-0.24	-0.37	0.59**	0.28	0.18
	(0.28)	(0.43)	(0.30)	(0.25)	(0.57)	(0.37)
no. of children	0.04	0.10**	0.01	-0.04	-0.06	-0.04*
	(0.03)	(0.05)	(0.03)	(0.03)	(0.05)	(0.03)
wealth	-0.06	0.02	-0.42***	0.05	-0.08	0.42**
	(0.09)	(0.14)	(0.13)	(0.08)	(0.17)	(0.16)
inverse Mill's ratio	0.53**	0.15	0.19	-0.39*	0.05	-0.15
	(0.22)	(0.42)	(0.29)	(0.22)	(0.40)	(0.36)
constant	0.53	0.92	0.53	-1.07***	-1.41*	-0.75
	(0.41)	(0.72)	(0.41)	(0.39)	(0.82)	(0.52)
observations	1,289	705	1,240	1,289	705	1,240
Wald test of exogeneity	0.03	0.60	0.56	0.00	0.09	0.19

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table E4.4: Simultaneous equation model accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.36*** **	**0.16**	**-0.21**	**-0.48*** **	**-0.02**	**-0.21**
	(0.13)	**(0.24)**	**(0.18)**	**(0.13)**	**(0.27)**	**(0.24)**
age	0.00	0.01**	0.01***	0.02***	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	-0.77***	-1.07***	-0.94***	0.34**	1.03***	0.40
	(0.15)	(0.22)	(0.21)	(0.15)	(0.24)	(0.25)
other urban areas	-0.44***	-0.41***	-0.72***	0.29**	0.40**	0.36**
	(0.13)	(0.15)	(0.12)	(0.14)	(0.18)	(0.14)
no. of children	0.02*	0.05***	0.03*	-0.01	-0.03	-0.04**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
wealth	-0.13***	-0.07	-0.17***	0.16***	0.03	0.13**
	(0.03)	(0.05)	(0.05)	(0.03)	(0.06)	(0.06)
inverse Mill's ratio	0.15	0.26**	0.06	-0.06	-0.13	0.07
	(0.11)	(0.12)	(0.11)	(0.11)	(0.13)	(0.13)
constant	0.31*	0.47**	0.81***	-1.08***	-1.29***	-1.42***
	(0.17)	(0.23)	(0.19)	(0.18)	(0.27)	(0.24)
observations	1,289	705	1,240	1,289	705	1,240

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table E4.5: 2SLS model accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**0.28****	**0.10**	**0.04**	**-0.32****	**-0.00**	**-0.07**
	(0.13)	**(0.17)**	**(0.11)**	**(0.13)**	**(0.13)**	**(0.07)**
age	-0.01***	-0.00	0.00*	0.01***	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	-0.32***	-0.41***	-0.15	0.16	0.34***	0.03
	(0.11)	(0.13)	(0.11)	(0.11)	(0.13)	(0.10)
other urban areas	-0.27***	-0.06	-0.05	0.20**	0.05	0.01
	(0.10)	(0.10)	(0.07)	(0.09)	(0.09)	(0.06)
no. of children	0.01	0.02**	0.00	-0.01	-0.01	-0.00
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)
wealth	-0.02	0.00	-0.08***	0.02	-0.01	0.06**
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
inverse Mill's ratio	0.20**	0.06	0.02	-0.15*	-0.00	-0.01
	(0.09)	(0.10)	(0.04)	(0.09)	(0.08)	(0.03)
constant	0.70***	0.82***	0.75***	0.11	0.06	0.18***
	(0.14)	(0.14)	(0.07)	(0.12)	(0.13)	(0.07)
observations	1,289	705	1,240	1,289	705	1,240
R-squared	0.08	0.22	0.16	0.05	0.16	0.08

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

E5 Migration instead of remittances

Table E5: Probit model accounting for selection & endogeneity (first-stage OLS)

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
migration	**-0.39**	**0.53**	**-0.14**	**-0.00**	**-1.54****	**-0.26**
	(0.35)	**(1.36)**	**(0.79)**	**(0.37)**	**(0.63)**	**(0.97)**
age	-0.02***	-0.01	0.01	0.03***	0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Dakar	-0.72**	-0.94	-0.56	0.45	0.34	0.13
	(0.30)	(0.71)	(0.44)	(0.29)	(0.63)	(0.56)
other urban areas	-0.60**	-0.07	-0.40	0.56**	0.03	0.24
	(0.27)	(0.41)	(0.29)	(0.26)	(0.37)	(0.37)
no. of children	0.05**	0.08	0.01	-0.05*	-0.01	-0.04
	(0.02)	(0.06)	(0.03)	(0.03)	(0.06)	(0.03)
wealth	-0.02	0.00	-0.40***	0.01	0.03	0.36**
	(0.09)	(0.13)	(0.12)	(0.08)	(0.11)	(0.14)
constant	1.24***	0.70	0.86	-1.65***	-0.09	-1.02
	(0.41)	(1.06)	(0.56)	(0.36)	(0.85)	(0.82)
observations	1,348	732	1,289	1,348	732	1,289
Wald test of exogeneity	0.05	0.65	0.81	0.37	0.04	0.81

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

E6 Employment in general

Table E6.1: Probit model accounting for selection & endogeneity (first-stage Tobit)

	(1) High education	(2) Low education	(3) No education
remittances p.c.	**-0.01**	**0.06**	**0.02**
	(0.05)	**(0.09)**	**(0.10)**
age	0.02*	-0.01	0.01*
	(0.01)	(0.02)	(0.01)
Dakar	-1.00	-0.41	-0.71
	(0.81)	(0.38)	(0.56)
other urban areas	-0.57	-0.00	-0.49
	(0.77)	(0.46)	(0.37)
no. of children	0.00	0.11**	-0.03
	(0.03)	(0.05)	(0.05)
wealth	-0.01	-0.06	-0.28**
	(0.11)	(0.17)	(0.14)
residual	0.04	-0.05	-0.08
	(0.06)	(0.10)	(0.13)
inverse Mill's ratio	0.25	0.38	0.19
	(0.30)	(0.51)	(0.35)
constant	1.00	1.02**	1.29***
	(0.93)	(0.44)	(0.39)
observations	1,291	707	1,245

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table E6.2: Probit model using two-step Newey estimator and accounting for selection & endogeneity

	(1) High education	(2) Low education	(3) No education
remittances p.c.	**-0.02**	**0.01**	**-0.05***
	(0.02)	**(0.03)**	**(0.03)**
age	0.03***	0.01*	0.02***
	(0.00)	(0.01)	(0.00)
Dakar	-0.93***	-0.55**	-1.10***
	(0.20)	(0.25)	(0.26)
other urban areas	-0.46**	-0.28*	-0.86***
	(0.19)	(0.17)	(0.15)
no. of children	0.02	0.05**	0.00
	(0.02)	(0.02)	(0.02)
wealth	0.04	-0.06	-0.14**
	(0.04)	(0.06)	(0.06)
inverse Mill's ratio	0.10	0.25*	0.14
	(0.13)	(0.14)	(0.14)
constant	0.66***	0.78***	1.13***
	(0.24)	(0.30)	(0.25)
observations	1,289	705	1,240
Wald test of exogeneity	0.11	0.79	0.64

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table E6.3 Probit model accounting for selection & endogeneity (first-stage OLS)

	(1) High education	(2) Low education	(3) No education
remittances p.c.	**-0.02**	**0.09**	**-0.02**
	(0.06)	**(0.11)**	**(0.10)**
age	0.02*	-0.01	0.01*
	(0.01)	(0.02)	(0.01)
Dakar	-0.96	-0.39	-0.78
	(0.80)	(0.38)	(0.58)
other urban areas	-0.53	-0.00	-0.48
	(0.75)	(0.45)	(0.37)
no. of children	0.00	0.10**	-0.02
	(0.03)	(0.05)	(0.05)
wealth	-0.01	-0.08	-0.25*
	(0.11)	(0.17)	(0.14)
inverse Mill's ratio	0.20	0.49	0.12
	(0.32)	(0.51)	(0.40)
constant	1.04	0.87*	1.38***
	(0.94)	(0.46)	(0.44)
observations	1,289	705	1,240
Wald test of exogeneity	0.43	0.22	0.91

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table E6.4: Simultaneous equation model accounting for selection & endogeneity

	(1) High education	(2) Low education	(3) No education
remittances p.c.	**-0.02**	**0.02**	**-0.05***
	(0.02)	**(0.04)**	**(0.03)**
age	0.03***	0.01**	0.02***
	(0.00)	(0.00)	(0.00)
Dakar	-0.94***	-0.54**	-1.10***
	(0.20)	(0.27)	(0.24)
other urban areas	-0.47**	-0.28	-0.87***
	(0.19)	(0.19)	(0.15)
no. of children	0.02	0.05**	0.00
	(0.02)	(0.02)	(0.02)
wealth	0.04	-0.07	-0.14***
	(0.04)	(0.06)	(0.05)
inverse Mill's ratio	0.10	0.25	0.14
	(0.13)	(0.16)	(0.14)
constant	0.67***	0.76***	1.14***
	(0.23)	(0.28)	(0.23)
observations	1,289	705	1,240

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table E6.5: 2SLS model accounting for selection & endogeneity

	(1) High education	(2) Low education	(3) No education
remittances p.c.	**-0.00**	**0.01**	**-0.00**
	(0.01)	**(0.01)**	**(0.01)**
age	0.00**	-0.00	0.00**
	(0.00)	(0.00)	(0.00)
Dakar	-0.16**	-0.07	-0.12
	(0.08)	(0.05)	(0.08)
other urban areas	-0.07	-0.01	-0.03
	(0.06)	(0.05)	(0.03)
no. of children	0.00	0.01**	-0.00
	(0.01)	(0.00)	(0.00)
wealth	-0.00	-0.01	-0.03
	(0.02)	(0.02)	(0.02)
inverse Mill's ratio	0.05	0.06	0.01
	(0.07)	(0.08)	(0.03)
constant	0.81***	0.89***	0.92***
	(0.11)	(0.06)	(0.04)
observations	1,289	705	1,240
R-squared	0.05	0.04	0.08

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Appendix F: Women

F1 Main specifications

Table F1.1: Probit model accounting for selection & endogeneity (first-stage Tobit)

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**-0.02**	**0.03**	**0.03**	**-0.06**	**-0.02**	**-0.04**
	(0.04)	**(0.06)**	**(0.02)**	**(0.04)**	**(0.11)**	**(0.05)**
age	0.01*	0.03**	0.01**	0.01*	0.02	-0.00
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Dakar	0.18	-0.64	0.20	-0.22	0.53	1.20**
	(0.40)	(0.53)	(0.20)	(0.48)	(1.11)	(0.50)
other urban areas	0.10	-0.99**	-0.26*	-0.29	0.71	1.05***
	(0.33)	(0.40)	(0.14)	(0.47)	(0.77)	(0.38)
no. of children	-0.01	-0.04	0.00	-0.01	-0.05	0.02
	(0.03)	(0.03)	(0.01)	(0.04)	(0.06)	(0.06)
wealth	-0.30***	-0.23	-0.32***	0.25***	-0.07	-0.17
	(0.10)	(0.15)	(0.06)	(0.09)	(0.26)	(0.13)
residual	-0.01	-0.11	-0.00	0.05	-0.12	0.06
	(0.04)	(0.07)	(0.03)	(0.05)	(0.12)	(0.06)
inverse Mill's ratio	-0.10	0.21	-0.59***	-0.38	-0.17	-0.06
	(0.30)	(0.43)	(0.15)	(0.28)	(0.79)	(0.38)
constant	-0.96**	-0.64	-0.52**	-0.91	-2.48**	-2.64***
	(0.42)	(0.54)	(0.21)	(0.58)	(1.12)	(0.78)
observations	1,220	550	2,883	1,220	550	2,883

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table F1.2: Probit model using two-step Newey estimator and accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**-0.01**	**0.04**	**-0.01**	**-0.02**	**0.01**	**-0.03**
	(0.02)	**(0.03)**	**(0.01)**	**(0.02)**	**(0.04)**	**(0.02)**
age	0.02***	0.02***	0.02***	0.01**	-0.00	-0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Dakar	-0.44**	-0.75***	-0.18	0.46**	1.03***	0.82***
	(0.18)	(0.22)	(0.11)	(0.22)	(0.39)	(0.21)
other urban areas	-0.08	-0.65***	-0.17***	0.19	0.62*	0.38**
	(0.15)	(0.15)	(0.06)	(0.21)	(0.32)	(0.17)
no. of children	-0.01	-0.02	0.01	-0.04**	-0.03	-0.04
	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)
wealth	-0.10**	-0.06	-0.15***	0.19***	-0.02	0.15***
	(0.04)	(0.05)	(0.02)	(0.04)	(0.08)	(0.06)
inverse Mill's ratio	-0.17	0.28	-0.35***	-0.10	0.11	0.02
	(0.15)	(0.21)	(0.08)	(0.16)	(0.32)	(0.21)
constant	-0.81***	-0.75***	-0.83***	-1.30***	-2.03***	-1.48***
	(0.20)	(0.26)	(0.10)	(0.23)	(0.42)	(0.28)
observations	1,219	550	2,875	1,219	550	2,875
Wald test of exogeneity	0.51	0.31	0.35	0.21	0.12	0.13

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table F1.3: Probit model accounting for selection & endogeneity (first-stage OLS)

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**-0.03**	**-0.01**	**0.03**	**-0.04**	**0.06**	**-0.04**
	(0.04)	**(0.10)**	**(0.03)**	**(0.04)**	**(0.10)**	**(0.04)**
age	0.01*	0.03**	0.01**	0.01	0.02*	-0.00
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Dakar	0.18	-0.65	0.14	-0.20	0.50	1.14**
	(0.40)	(0.52)	(0.21)	(0.48)	(0.95)	(0.48)
other urban areas	0.09	-1.00**	-0.30**	-0.27	0.79	1.01***
	(0.33)	(0.42)	(0.14)	(0.47)	(0.68)	(0.35)
no. of children	-0.01	-0.04	0.00	-0.01	-0.07	0.02
	(0.03)	(0.03)	(0.01)	(0.04)	(0.06)	(0.06)
wealth	-0.30***	-0.21	-0.31***	0.23**	-0.17	-0.15
	(0.09)	(0.16)	(0.06)	(0.09)	(0.23)	(0.12)
inverse Mill's ratio	-0.13	0.05	-0.49***	-0.32	0.23	-0.05
	(0.32)	(0.52)	(0.18)	(0.30)	(0.66)	(0.45)
constant	-0.92**	-0.41	-0.56**	-0.96	-2.74***	-2.55***
	(0.44)	(0.66)	(0.22)	(0.59)	(0.84)	(0.68)
observations	1,219	550	2,875	1,219	550	2,875
Wald test of exogeneity	0.90	0.74	0.95	0.88	0.00	0.18

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

Table F1.4: Simultaneous equation model accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**-0.01**	**0.04**	**-0.01**	**-0.02**	**0.02**	**-0.03**
	(0.02)	**(0.03)**	**(0.01)**	**(0.02)**	**(0.04)**	**(0.03)**
age	0.02***	0.02***	0.02***	0.01**	0.00	-0.02***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
Dakar	-0.44**	-0.83***	-0.19*	0.46**	0.93**	0.82***
	(0.18)	(0.24)	(0.11)	(0.21)	(0.39)	(0.23)
other urban areas	-0.07	-0.70***	-0.17***	0.19	0.56*	0.39**
	(0.15)	(0.16)	(0.06)	(0.19)	(0.30)	(0.17)
no. of children	-0.01	-0.02*	0.01	-0.04**	-0.03	-0.04**
	(0.01)	(0.01)	(0.01)	(0.02)	(0.03)	(0.02)
wealth	-0.10**	-0.06	-0.15***	0.19***	0.00	0.15***
	(0.04)	(0.06)	(0.02)	(0.04)	(0.09)	(0.05)
inverse Mill's ratio	-0.17	0.32	-0.35***	-0.10	0.13	0.02
	(0.15)	(0.22)	(0.09)	(0.15)	(0.34)	(0.20)
constant	-0.81***	-0.76***	-0.84***	-1.30***	-2.02***	-1.47***
	(0.20)	(0.26)	(0.11)	(0.23)	(0.45)	(0.25)
observations	1,219	550	2,875	1,219	550	2,875

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table F1.5: 2SLS model accounting for selection & endogeneity

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**-0.01**	**-0.01**	**0.01**	**-0.01**	**0.01**	**-0.00**
	(0.01)	**(0.03)**	**(0.01)**	**(0.01)**	**(0.01)**	**(0.00)**
age	0.00*	0.01**	0.00**	0.00	0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Dakar	0.03	-0.24	0.05	-0.07	0.04	0.06**
	(0.11)	(0.16)	(0.07)	(0.10)	(0.06)	(0.03)
other urban areas	0.01	-0.37***	-0.10**	-0.09	0.06	0.05***
	(0.10)	(0.13)	(0.05)	(0.09)	(0.04)	(0.02)
no. of children	-0.00	-0.01	0.00	-0.00	-0.00	0.00
	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
wealth	-0.08***	-0.07	-0.11***	0.07***	-0.01	-0.01
	(0.02)	(0.05)	(0.02)	(0.02)	(0.01)	(0.01)
inverse Mill's ratio	-0.04	-0.00	-0.18***	-0.08	0.00	-0.00
	(0.09)	(0.15)	(0.06)	(0.07)	(0.04)	(0.02)
constant	0.20	0.41**	0.30***	0.19	-0.03	0.00
	(0.13)	(0.19)	(0.08)	(0.12)	(0.05)	(0.02)
observations	1,219	550	2,875	1,219	550	2,875
R-squared	0.05	0.22	0.09	0.06	0.01	0.02

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

F2 Migration instead of remittances

Table F2: Probit model accounting for selection & endogeneity (first-stage OLS)

	Self-employment			Wage employment		
	(1)	(2)	(3)	(4)	(5)	(6)
	High education	Low education	No education	High education	Low education	No education
remittances p.c.	**-0.28**	**-0.94**	**1.16*** **	**-0.47**	**-0.48**	**-0.20**
	(0.58)	**(0.75)**	**(0.26)**	**(0.55)**	**(1.11)**	**(1.55)**
age	0.01**	0.02*	0.01**	0.01*	0.02	-0.00
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Dakar	-0.02	-0.98**	0.13	-0.44	0.04	1.18
	(0.42)	(0.43)	(0.20)	(0.50)	(0.62)	(0.89)
other urban areas	-0.04	-1.09***	-0.30**	-0.36	0.37	1.06**
	(0.35)	(0.33)	(0.14)	(0.49)	(0.65)	(0.47)
no. of children	-0.01	-0.02	-0.02*	-0.01	-0.03	0.02
	(0.03)	(0.03)	(0.01)	(0.04)	(0.07)	(0.04)
wealth	-0.24**	-0.09	-0.28***	0.30***	0.05	-0.19
	(0.11)	(0.17)	(0.05)	(0.09)	(0.19)	(0.22)
constant	-0.83	0.31	-1.30***	-0.93	-1.94	-2.65
	(0.53)	(0.73)	(0.20)	(0.70)	(1.45)	(1.91)
observations	1,288	576	3,019	1,288	576	3,019
Wald test of exogeneity	0.75	0.14	0.00	0.24	0.26	0.82

Note: Jackknifed standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Estimations take into account sample weights.

4 Remittances, Migration and Child Education

4.1 Introduction

In chapter 3, I found that the relationship between remittances and labor market outcomes of non-migrant household members is moderated by the level of education the recipients attained. This chapter focuses on the direct impact of remittances on child education in households receiving remittances. If remittances increase child human capital then they may contribute to a virtuous circle: Remittances would increase the educational level of non-migrant household members and better educated household members may also use them for productive investment (see chapter 3). Higher income from productive investment may then increase education levels even more. If remittances do not exhibit a positive effect on child education, then it appears that alleviating credit constraints is more important for labor market decisions than for educational ones and education levels may be better explained by other factors.

Most studies on the impact of migration and remittances on child human capital investments have focused on Mexico and countries further to the south due to their high migration flows into the United States. This relationship is little researched in the context of Sub-Saharan Africa even though emigration flows from some of these countries are considerable and remittances constitute a notable share of GDP (see section 3.1). There are several noteworthy points to motivate the study of these countries separately. Almost all African countries do not have land borders with high-income countries making illegal migration and frequent moves between home and these destination countries more

burdensome. Moreover, since GDP is generally very low in Sub-Saharan African countries, liquidity constraints of households may be a major concern and child labor more frequent to sustain household consumption levels. In addition, school enrolment and educational attainment remain relatively low, which may have implications for the expected returns of additional years of education and general preferences towards education. Concerning the methodological analyses, none of the existing studies has included both migration and remittances simultaneously as separate variables rendering the interpretation of their results unclear.

To the best of my knowledge, this is the first analysis that disentangles the effects of migration and remittances and seeks to establish the sign and the quantity of each effect. This is important since migration could have positive and negative effects on child education (for example due to the absence of a parent) and the net effect has to be identified empirically. On the other hand, remittances are likely to have positive effects (as they can reduce household liquidity constraints). The interpretation of, for instance, a positive effect of remittances would be unclear if only the latter is included without controlling for migration since counteracting negative effects of migration are not considered in this set-up. This analysis points out the different channels, through which migration and remittances may affect investment in child human capital and illustrates in detail why both variables need to be included for appropriate identification of the respective effects.

Moreover, this study embeds these dynamics in a general theoretical model that includes the education level of parents who are likely to be the ultimate decision makers with respect to child education. The subsequent empirical model operationalizes the unified framework. My results show that neither migration nor remittances exhibit a significant effect on child educational attainment for the data set on Senegalese households used in this chapter.

To investigate the reasons for the lack of an effect, the main transmission channel, through which migration and remittances were expected to affect child education, is examined: The effect of both of these variables on education expenditures that are supposed to ultimately influence child education. Migration and remittances are insignificant in these estimations as well suggesting that they do not affect educational attainment of children (partly) because they do not change household spending behavior with respect to education expenditure. However, we find a highly significant effect of average adult schooling on child education that persists even if education expenditure is controlled for. This therefore suggests that adult schooling is important for child education beyond education spending.

The remainder of this chapter is structured as follows. Section 4.2 gives a brief overview over the results in the recent literature on the impact of migration and remittances on child human capital in origin households. Section 4.3 explains how migration and remittances may affect child education and establishes the framework to deal with both effects simultaneously. The data used for this analysis are described in section 4.4 followed by the econometric set-up and results in section 4.5. Finally, section 4.6 concludes.

4.2 The impact of migration and remittances on child education

Most studies on the relationship between migration, remittances and child education focus on the effect of remittances. Calero, Bedi, and Sparrow (2009) show that remittances have a positive effect on school enrolment in Ecuador, specifically for girls and in rural areas. Moreover, they find evidence that remittances might increase the quality of education investments as children are more likely to be enrolled in private schools substituting for public schools. Acosta (2011) does not find a significant effect of remittances on school enrolment of boys in El Salvador. In contrast, girls were more likely to be enrolled in

response to remittances. However, older students aged 15 to 18 years were more likely to drop out of school. Cox-Edwards and Ureta (2003) find that higher amounts of remittances in El Salvador are associated with a lower hazard of leaving school. Moreover, the presence of remittances lowers the hazard of leaving school only in rural areas.

Yang (2008) examines exchange rate shocks during the Asian financial crisis that increased the value of migrant earnings abroad if these shocks were favorable and decreased them if they were unfavorable. He shows that positive exchange rate shocks lead to increased child schooling in the Philippines.

Hanson and Woodruff (2003) show that girls in migration households in Mexico accumulate more years of schooling if their mothers have little education whereas results for boys are inconclusive. In addition, they find that the presence of remittances increases child schooling. They argue that both results suggest that migration (and subsequent receipt of remittances) relax credit constraints and help increase child education (Hanson and Woodruff, 2003, p.24). In line with these results, Mansuri (2006) finds that children in migration households in Pakistan are less likely to drop out and accumulate more years of schooling. However, in female-headed migrant households, girls are more likely to drop out than in male-headed migrant households. Moreover, girls in such households do not differ in their years of schooling from girls in non-migrant households. McKenzie and Rapoport (2011) find that migration in Mexico lowers school attendance and attainment for boys aged 12 to 18 and girls aged 16 to 18. They suggest that these results confirm the notion that migration increases opportunity costs and lowers the expected returns to education (McKenzie and Rapoport, 2011, p.1355). Antman (2012) finds that paternal international migration increases girls' schooling but does not impact on education of boys in Mexico. Domestic migration of fathers does not show any effect, which suggests that absence of fathers is not the main transmission

channel. Finally, Gyimah-Brempong and Asiedu (2014) show that international remittances to households in Ghana increase the probability of child enrolment in primary and secondary school and that this effect is stronger if remittances are sent to female-headed households.

This brief overview of the literature shows that there is little evidence on this subject in the context of Sub-Saharan Africa. Moreover, the results are ambiguous. Most of the studies using data from Latin America suggest that remittances and migration have positive effects on education outcomes for girls only. Some studies, however, find insignificant or negative effects of migration. A disadvantage of these studies is that the respective effects of migration and remittances are not distinguishable from one another as they have been used synonymously in the empirical analyses. The next section discusses the different channels by which migration and remittances may affect child education and how both can be included in a unified framework.

4.3 Theory

Migration and remittances are interconnected in the sense that rarely a household receives remittances if it does not have a migrant family member. As both migration and remittances may impact on educational outcomes in a number of ways and as their effects are ambiguous it is essential to consider their effects in an encompassing unified framework.

4.3.1 Impact of migration on child education

Migration of a parent may disrupt family life with ambiguous effects on child schooling. For example, a child in a migration household lacks supervision by the adult

migrant (Gyimah-Brempong and Asiedu, 2014; Mansuri, 2006) who may act as a role model (Hanson and Woodruff, 2003) and give educational inputs such as help with homework (Gyimah-Brempong and Asiedu, 2014; McKenzie and Rapoport, 2011). Children may have to replace the adult migrant by doing household work such as taking care of siblings (Hanson and Woodruff, 2003; Mansuri, 2006; McKenzie and Rapoport, 2011) or may even become wage-earners to compensate for the possible losses in income due to migration (McKenzie and Rapoport, 2011). Absence of a parent may also impose psychological costs such as emotional stress on the child (Antman, 2012; Mansuri, 2006) leading to poorer educational outcomes such as early dropout from school or low achievement and grade retention.

Moreover, if migrants do not legally enter destination countries, then they are likely to be employed in jobs requiring low levels of education. Prospect of future migration would therefore lead to lower educational attainment of children in migration households (see McKenzie and Rapoport, 2011, p.1333).

The arguments above suggest that migration should have a negative effect on educational outcomes of children. There are, however, some arguments that point to an opposite, positive connection between migration and child education.

For instance, household investment in child education may rise if the expected returns from education are believed to be high in case of migration (Gyimah-Brempong and Asiedu, 2014; McKenzie and Rapoport, 2011). This would naturally be the case if the domestic labor market does not highly reward additional years of schooling and if migration is legal and therefore job opportunities requiring higher levels of education are attainable in the destination country.

Another line of argument emphasizes the role of the family structure. Parents transmit their values to their children and mothers and fathers may attach varying importance to child

education. If fathers migrate, mothers may have increased decision power regarding the education of the children. These differential preferences may result in higher schooling outcomes if mothers decide upon child education (Mansuri, 2006; see also Hanson and Woodruff, 2003). Similarly, the migration experience may change educational preferences towards children if education is valued more in destination countries and if migrants (at least) partially adopt these values and transmit them to their origin households. An example would be a migration from a developing country with low educational attainment to an OECD country with typically very high levels of schooling in general. For instance, Böhme (2012) finds a positive link between migration and educational aspirations of parents in Moldova.

4.3.2 Impact of remittances on child education

Regarding remittances, most studies argue that transfers from migrants to their origin households could reduce liquidity constraints, increase human capital investments and therefore have positive effects on child education (Mansuri, 2006; Calero et al., 2009; Acosta, 2011; Cox-Edwards and Ureta, 2003; Yang, 2008; McKenzie and Rapoport 2011; Hanson and Woodruff, 2003). Remittances may increase the reservation wage of a child and therefore decrease labor force participation leading to better educational outcomes (Calero et al., 2009, p.1143). They may also be part of a household strategy to diversify income and smooth consumption in response to economic shocks (Calero et al., 2009, p.1143).

Cox-Edwards and Ureta (2003, p.438) argue that parents decide upon schooling investments regarding their children based on cost-benefit considerations. Their expectations of future labor market returns on formal schooling are weighed against education costs such as those related to school attendance or opportunity costs of schooling (see also Hanson and

Woodruff, 2003). In this framework, parents choose more schooling for their children if they receive remittances since they are less dependent on their children's labor.

4.3.3 Migration and remittances in a single framework

While many of the above studies emphasize that both migration and remittances have important effects on educational outcomes of children in origin households, none of the studies simultaneously introduces both in the econometric analyses.

McKenzie and Rapoport (2011) acknowledge that migration and remittances have very distinct transmission channels in their impact on child schooling. However, they only include a binary variable indicating whether a child lives in a migration household and interpret the result as the net effect of migration and remittances. This is a very broad and encompassing interpretation of the effect. Assuming that there are no households that receive remittances if they do not have a migrant household member there is still variation among migration households. A considerable number of migrants do not send back any remittances to their families at all.[45] Therefore, a variable capturing migration may capture a migrant household that does not receive remittances or migrant households receiving very distinct amounts of remittances. The explanatory power of a migration variable is therefore unclear.

In contrast, other studies (e.g. Acosta, 2011; Calero et al., 2009) have included the amount or presence of remittances as predictors without controlling for the presence of migration. The problems are analogous. Positive amounts of remittances denote migration and remittances combined. But variation is still present for the households that do not receive

[45] For example, in the data used in this chapter about 22 per cent of migration households with children in the relevant age range do not receive remittances.

remittances. They may be migration or non-migration households making it unclear what effect the variable for remittances actually captures.

Methodologically, the most convincing approach is chosen by those studies that confine their data set to migration households only and estimate the impact of remittances on child education outcomes (e.g. Acosta, 2011[46]; Yang, 2008). The effect of remittances can therefore be interpreted as the effect of alleviating credit constraints for the subset of households that have sent a migrant abroad. It has even been argued that the determinants to migrate and to remit may be the same and, if so, selection to migration is not a problem if migration households only are considered (Acosta, 2011, p.926).[47] Two interconnected problems arise from the latter approach. First, the question to what extent migration affects schooling outcomes is of fundamental theoretical interest in this literature and should be contrasted to (possibly counteracting) effects of the receipt of remittances. Second, if migrant households differ systematically from non-migrant households, then the effect of remittances (or additional financial means) for the subset of migration households is not representative of the whole population. For example, assume that migration households are less risk averse than non-migration households as they chose to send a migrant abroad, which may require considerable up-front costs and involves subsequent uncertainties about the success of migration. A lower level of risk aversion may cause these households to allocate additional financial resources in a different manner than non-migration households. This variation in the use of financial means is likely to also lead to variation in its impact on schooling outcomes of

[46] Acosta (2011) does both: Analyses with the whole sample and the subset of migration households.
[47] It is, however, unlikely that the determinants to migrate are entirely the same as the determinants to remit since typically a considerable number of migrants do not remit.

children.[48] Less risk-averse households may for instance channel more resources into a new risky business, leaving less for education investments or even causing children to neglect school for work in this business. Many different ways in which differential use of resources impacts on human capital investments are conceivable. We may conclude that migration and remittances need to be accounted for in one unified framework that tackles endogeneities in both variables to disentangle the respective effects.

4.3.4 A simple model

The following formal theoretical model adapted from McKenzie and Rapoport (2011, pp.1342-1345) serves to illustrate the arguments regarding migration and remittances made so far. The number of years of schooling s of a child i is decided upon by the household, which will weigh the benefits against the costs of an additional year of schooling. The benefits of an additional year in school are denoted $r_{i,s}$ depicting the present discounted value of the additional returns. The costs of an additional year at school may be financial, $c_{i,s}$, including schooling fees, costs for school material or foregone earnings. In the model of McKenzie and Rapoport (2011), non-financial costs in terms of disutility of school effort are distinguished from the financial costs. However, it is not necessary to consider these costs separately for the purposes of this study. For simplicity, I therefore subsume costs in the parameter $c_{i,s}$. The costs of schooling may not exceed the available resources of the household, A_i.The schooling decision of the household for child i therefore is:

[48] Migration can also be considered to be a risk diversification strategy (see Azam and Gubert, 2005) and therefore a symptom of greater risk aversion among migration households. Analogously, the argument of differential usage of additional financial resources between migration and non-migration households persists.

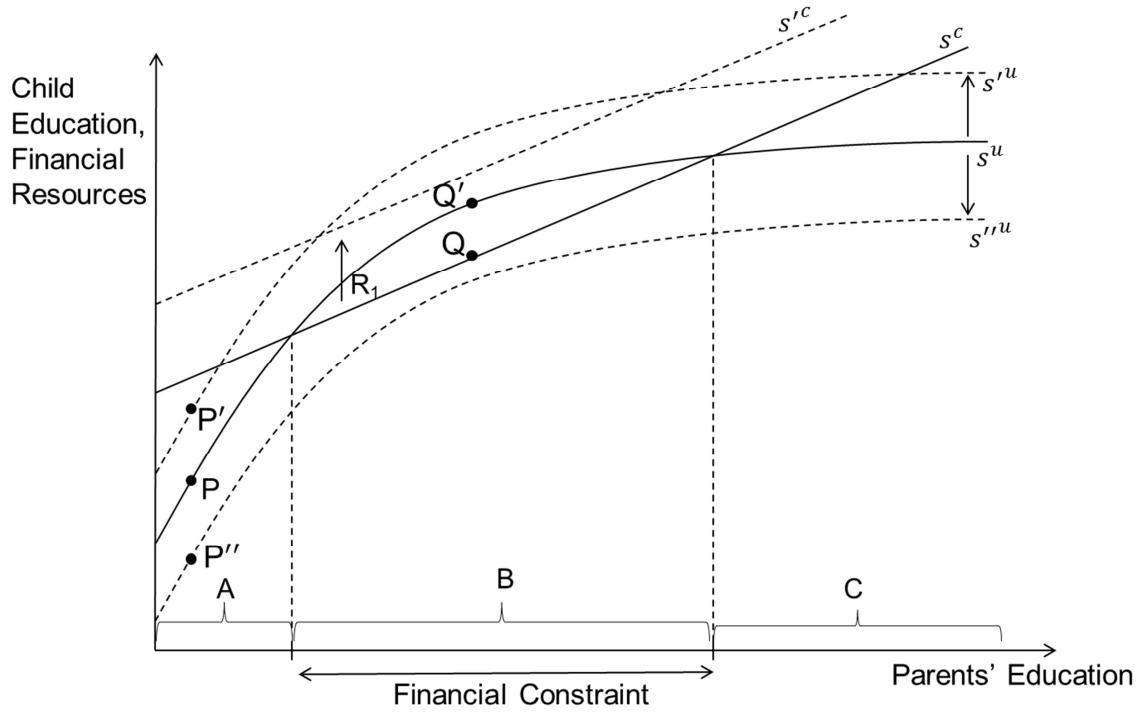
$$s_i^* = \underset{s \in \{0,1,2,3\ldots,N\}}{\arg\max} \sum_{j=1}^{s} (r_{i,j} - c_{i,j}) \qquad s.t. \sum_{j=1}^{s} c_{i,j} \leq A_i \quad (4.1)$$

If the household does not face liquidity constraints the optimal level of schooling is s_i^u. Schooling of children is expected to be positively related to parents' education as more educated parents may help with homework or simply care more for the education of their children than less educated parents (see McKenzie and Rapoport, 2011, p.1342). The higher the level of schooling the more independent children may become with respect to their educational decisions and the less parents may be able to use their knowledge to directly support their children. Therefore, the relationship between parents' education and child schooling is depicted as a concave function in Figure 4. Moreover, financial resources of the household are expected to be positively related to parents' education since well-educated parents are likely to have better-paid jobs and a higher income than low-educated parents. The straight positive line in Figure 4 shows this positive relationship. The number of schooling years is constrained, s_i^c, if the liquidity constraint of the household is binding. However, it is possible that schooling preferences result in lower than possible educational attainment given the financial constraint. This would be the case if the household was financially endowed to finance more years in school for the household's children but the value attached to more schooling years is too low. This scenario is depicted in areas A and C in Figure 4. For example in point P, the preferred schooling level for children is below the affordable one. Higher education of parents, however, would increase child schooling as we would move upwards along the concave function.

Let us now consider what happens if the household receives remittances indicated by the upward shift of the straight line depicting the financial constraint. At point P, this has no

implications since there was no financial constraint in the first place and child schooling therefore does not change. What about point Q in the area B, which is subject to a binding financial constraint? Here, the receipt of remittances at the indicated level alleviates the constraint and allows to reach Q', the preferred level of child schooling. Formally in point Q' we have $\sum_{j=1}^{s} c_{i,j} < A_i$. This also shows that it is crucial to include the amount of remittances (not just their presence) received by the household in any such analysis to find out if financial constraints are responsible for lower than otherwise preferred schooling levels. Note that a higher level of parents' schooling still implies higher levels of child education in area B. However, in this area, we do not move along the unconstrained schooling level but along the budget constraint.

Figure 4: Educational attainment, migration and remittances



So far we have only looked at the implications of a change in parent's education or remittances. As discussed above, migration may change preferences towards schooling in one

or the other direction. Consider the case where paternal migration leaves the mother with decision making power over schooling of the children and her preferences towards child schooling are more favorable (see Antman, 2012). In this case, the concave function depicting the optimal unconstrained schooling level would shift upwards. In contrast, if schooling preferences decreased because of a lack of a role model or emotional stress for the child (see Hanson and Woodruff, 2003; Antman, 2012), the function would shift downwards. Looking at point P, an upward shift would increase child schooling to P', a downward shift would decrease it to P'' and if positive and negative effects cancel out, the schooling level would remain at P. In all three scenarios remittances do not play a role because the financial constraint is not binding.

In contrast, in point Q, a potentially positive effect of migration may not materialize as households are constrained financially. Even a negative effect of migration may not show if it does not shift downwards the concave function far enough, that is below Q.

This figure and the concepts of financial constraints and changing educational preferences that it contains serve to illustrate why it is highly important to disentangle the respective effects remittances and migration may have on schooling decisions. Let us combine the insights of the arguments to see how the results in the current literature may come about.

Starting in point Q, consider that we observe that a variable denoting migration and remittances combined increases schooling to point Q'. This is therefore the net effect of the migration and the remittances effect. In fact, there are three scenarios possible leading to this result. First, unconstrained schooling preferences, s^u, may have decreased or increased to point Q' or remained at this point and remittances may have alleviated credit constraints to reach point Q' as well. Second, unconstrained schooling levels have remained at a point higher than point Q' or increased or decreased to this higher point and remittance increased

the budget to reach point Q' only, constituting a credit constraint at this schooling level. Third and very importantly, unconstrained schooling preference may have moved to or stayed at point Q' and remittances may have increased s^c more than to this point. The last case shows that if remittances increased sufficiently, then it was household preferences that prevented higher levels of educational attainment than that of point Q'. Moreover, studies that consider migration households only may overlook the differences in financially unconstrained schooling preferences between migration and non-migration households. Those studies only allow remittances to change and therefore focus on financial constraints leaving out the possibility of restrictive preferences. In addition, parents' schooling always impacts positively on child schooling. The degree to which better educated parents positively affect child schooling depends on whether the household has a binding budget constraint and on the specific slopes of the respective functions. Table 4.1 summarizes the respective marginal effects that we may expect in the areas A, B and C of Figure 4.

Table 4.1: Expected marginal effects on child education

	$\frac{\text{d Child education}}{\text{d Migration}}$	$\frac{\text{d Child education}}{\text{d Remittances}}$	$\frac{\text{d Child education}}{\text{d Parents'education}}$
A	+ / -	0	+
B	0	+	+
C	+ / -	0	+

The expectations regarding the effects of migration and remittances clearly vary between the areas A, B and C. Whether we expect an effect of migration and remittances and its direction for the case of Senegal therefore depends on what area we expect the country to

be located in. Table 4.2 shows mean schooling years for a number of developing countries including those mentioned in the literature review and countries in the same region in order to get some insight about which area may be relevant for which countries. It also shows the stock of migrants abroad originating from these countries and the average amount of remittances per migrant sent back to these countries. The last column contains remittances as the share of GDP to inform about the importance of remittances for the relevant countries.

In the second column of Table 4.2, we can see that mean schooling of adults is very low for most of the selected Sub-Saharan African countries. The value for Senegal is only 2.42 years while it reaches 6.72 years for Ghana. In the Asian countries and in the Latin American countries shown, this value is generally much higher, up to 10.49 years in Belize. With respect to the areas in Figure 4, this means that countries in Latin America and Asia are further to the right than Sub-Saharan African countries. We could therefore conjecture that while Senegal may be in area A, other countries researched so far may rather be in area B. If this is the case, then the results for Senegal may differ from those found in the existing literature. According to the theory, remittances would be unlikely to affect child schooling in Senegal as the preferred schooling level is below the financial constraint. While parents' education should have a positive effect in area A according to the theory, the effect of migration is ambiguous as it depends on whether its positive or negative effects are stronger. However, we cannot theoretically explain where one area ends and the other starts and the sign of the net effect of migration. Therefore, the next sections set out to find empirical evidence for the effects of migration and remittances as well as the impact of adult schooling.

Table 4.2: Adult schooling, migration & remittances for selected countries

	Mean years of schooling in 2011[1)]	Stock of migrants abroad in 2013	Average remittances per migrant in 2013[4)]	Remittances (share of GDP in 2013)
Sub-Saharan Africa				
Senegal	2.42	533,085	3,027	10.65%
Mali	2.04	869,894	901	7.17%
Ghana[2)]	6.72	719,236	192	0.29%
Ethiopia	2.41	585,853	1,066	1.33%
Latin America				
Belize[2)]	10.49	62,570	1,189	4.64%
Colombia[2)]	7.07	2,448,385	1,683	1.09%
Costa Rica	8.31	130,364	4,575	1.20%
Ecuador[2)]	7.50	1,144,408	2,131	2.71%
El Salvador	6.35	1,526,093	2,602	16.37%
Honduras	5.53	659,606	4,754	16.91%
Mexico[2)]	8.34	13,212,419	1,742	1.83%
Uruguay	8.38	336,741	365	0.22%
South (East) Asia				
Pakistan	4.73	5,682,673	2,574	6.18%
Philippines[3)]	7.56	5,481,683	4,871	9.82%
Indonesia	7.51	2,992,338	2,545	0.88%
Malaysia[3)]	8.61	1,673,671	834	0.45%

[1)] Mean years of schooling of population aged 25 and above. [2)] Mean years of schooling in 2010. [3)] Mean years of schooling in 2000. [4)] In current US Dollars.
Source: UNESCO (2014b), United Nations (2013), World Bank (2014) and own calculations.

4.4 The Data

The data for this analysis come from the Migration and Remittances Household Survey 2009, which was carried out by the Consortium Pour La Recherche Économique et Sociale (CRES) and funded by the World Bank (World Bank, 2009). This data set is the same as the one used in the labor market analysis in chapter 3 (see its description in section 3.3).

Table 4.3 shows unweighted summary statistics of the variables used in the empirical analysis for all children aged between 7 and 19, which is during the time they would be at

primary or secondary school. The main dependent variable is *educational attainment*. This variable denotes the gap between the years of schooling a child should have accumulated according to their age if they had entered school at the age of seven (and have not dropped out or repeated a grade) and the actual years of schooling attained. For example, a nine-year old child should be in grade three (UNESCO-IBE, 2010). If she did not enter school by this age she would attain the value -3 for educational attainment. In some cases this number is positive, presumably because these children have entered school early or passed through school more quickly. The advantage of this measurement is that it captures several dimensions of educational attainment: If students do not enter school at all or drop out early their value will be very low. Similarly, if students have low achievements (for example due to absenteeism, work outside school or a lack of schooling equipment) and have to repeat a grade they will also attain lower values for this variable. On the other hand, students who enter school early, move quickly to subsequent grades and do not drop out are attributed higher values of educational attainment.

To measure more directly the channels through which the effect on schooling should work, further dependent variables are household expenditure on education as well as its share in total expenditure. The mean age of the children is about 13 years and there are roughly as many girls (49 percent) as boys in the sample. Most of the children live in Dakar or in other urban areas (56 percent). Mean schooling of the adults above 20 years is only about 3 years. The number of migrant households in the region is at least 10 percent and regarding the length of the duration of migration I consider the migrant with the longest duration as another very recent migrant in the household may not yet be sending remittances. As Table 4.3 shows

unweighted sample statistics the number of migration households appears to be very high at 71 percent.[49] The empirical analyses below take into account sample weights.

Table 4.3: Summary statistics

	Mean	Standard Dev.	Minimum	Maximum	N
Dependent Variables					
educational attainment	-3.04	4.11	-13.0	5	5458
expenditure on education	5776	9273.70	0.0	133333	5458
expenditure on education (share of total expenditure in %)	2.70	3.64	0.0	38	5458
Household Characteristics					
remittances (in 100.000 XOF)	6.06	13.03	0.0	125	5458
migration	0.71	0.46	0.0	1	5458
average adult schooling (above 20)	2.92	3.79	0.0	18	5458
age	12.69	3.81	7.0	19	5458
female	0.49	0.50	0.0	1	5458
Dakar	0.17	0.37	0.0	1	5458
other urban areas	0.39	0.49	0.0	1	5458
wealth	-0.20	1.56	-2.4	5	5458
no. of children	5.87	4.32	0.0	29	5458
migration network	0.62	0.19	0.1	1	5458
household size	13.30	7.50	2.0	57	5458
average adult age (above 20)	38.96	6.39	22.0	66	5458
average adult employment (above 20)	0.53	0.30	0.0	1	5458
duration of migration (max)	6.95	9.02	0.0	69	5458

Note: The table shows values for the unweighted data sample (estimations below include weights). *Educational attainment* is the main dependent variable and consists of the difference between the grade children should be attending according to their age and the highest grade they actually attained. Remittances are all monetary and in-kind transfers the migrants sent back to the household in the twelve months preceding the survey date. Migration is a dummy variable denoting one for migration households and zero otherwise. The wealth index is calculated from a principal component analysis carried out using long-term household characteristics that indicate wealth (such as whether the household has electricity or not, etc., see caption of Table 3.1). In this way I try to avoid capturing wealth that is induced by the receipt of remittances. The migration network is the share of migration households in the region multiplied with the square of the age of the household head to obtain variation across households within a region. The number of children contains all household children below the age of 20.

4.5 Methodology and results

In line with the unified theoretical framework that disentangled migration and remittances effects the empirical analysis will need to include both variables separately and

[49] Since many households have both domestic and international migration the latter are not easily separable and are used combined in this chapter.

identify the respective effects. There are some concerns, however, that migration as well as remittances may be endogenous. Migration households may differ from non-migration households in unobserved ways that may also affect the educational attainment of the household's children. For example, an economic shock may trigger the migration decision of a household member and at the same time it could induce a child to drop out from school in order to work and add to the household income (see Acosta, 2011). Similarly, unobserved household preferences may increase the amount of remittances and educational attainment or higher educational attainment of children may cause higher amounts of remittances sent by the migrants.

I attempt to mitigate these problems using an instrumental variable technique. In a first step I regress a dummy denoting migration on a number of household characteristics. In this regression I use a proxy for migration networks, the share of migration households in the region, as excluded instrument (see Hanson and Woodruff, 2003). The intuition behind this instrument is that migration is enhanced and facilitated if there exists a migration network that could help a prospective migrant to emigrate. The identifying assumption is that having a migration network per se does not change the educational attainment of the children of the respective household apart from its effect through the migration decision. Formally, we have

$$M_j = N_j\,\beta_N + H_j\beta_H + \upsilon_j \qquad (4.2)$$

where M is a binary variable indicating if a household j has sent a migrant abroad or not and N is the proxy of migration networks, that is a variable that indicates the number of migrant households in a district in Senegal. This variable is multiplied with the square of the age of the household head to attain variation on the household level (see Hanson and Woodruff,

2003; Acosta, 2011). As Hanson and Woodruff (2003, p.21-22) point out, household characteristics may be relevant for the migration decision and therefore are a suitable term for interaction with regional migration rates (as noted in section 3.4). While this achieves variation in the household level, a potential limitation may be that the square of the age of the household head used here may be directly linked with child schooling. Furthermore, H is a vector of other household characteristics that may influence the migration decision including average schooling of adults above 20 years. The latter proxies parents' education as it is not possible to disentangle the exact family relationships among the individuals of a household with the data used in this analysis.

In the next step, I regress remittances on household characteristics for migration households. Once migrated, the duration of migration may influence the amount of remittances as migrants who have stayed at their destination for a longer time period may have adapted to the new environment. They have had more time to find employment and to be promoted. They may also have acquired knowledge necessary in their job market. All these aspects may lead to higher remuneration and therefore to higher amounts of remittances sent back home. As remittances are left-censored at zero, I specify the following tobit model:

$$R_i = \begin{cases} R_i & if\ R_i^* = D_j\,\beta_D + H_j\beta_H + \mu_i > 0 \\ 0 & if\ R_i^* = D_j\,\beta_D + H_j\beta_H + \mu_i \leq 0\,, \end{cases} \qquad (4.3)$$

I estimate these first-stage regressions manually in separate steps as the equation for remittances is only possible for migration households.[50] The predicted values of migration and remittances obtained from these two steps are plugged into the outcome equation of interest:

$$E_i = \hat{R}_j \beta_{\hat{R}} + \hat{M}_j \beta_{\hat{M}} + H_j \beta_H + \varepsilon_i \qquad (4.4)$$

where E_i denotes educational attainment of child i and $\hat{R}_j$ and $\hat{M}_j$ are the predicted values for migration and remittances for household j. Since this method involves three distinct estimations the whole procedure is bootstrapped using 300 repetitions to obtain valid standard errors. I follow the literature (see section 4.2) in separating the estimations between girls and boys. We may expect different effects if, for example, parents believe that returns to education on the labor market are higher for men than for women[51]. To assess the validity of the instruments, table 4.4 shows results of estimations demonstrating the strength of the relationship between the instruments and the endogenous variables. Columns (1) and (2) show that migration networks are a highly significant predictor of household migration status for boys and girls. The reason is likely that migration networks facilitate migration as friends and relatives who have migrated may inform and help prospective migrants. Once migrated, the duration of migration has a strong positive and significant impact on the amount of remittances sent home by the migrants.

[50] Since the equation for remittances can only be estimated for migration households the values for remittances used in case of non-migration are zero. This also means that only remittances of former household members are considered.

[51] See the discussion on labor market choices for men and women in subsection 3.5.4.

Table 4.4: Relevance of instruments for migration & remittances

	(1)	(2)	(3)	(4)
	Migration		Remittances	
	Boys	Girls	Boys	Girls
migration network	0.11***	0.11***		
	(0.03)	(0.03)		
duration of migration			0.36***	0.34***
			(0.10)	(0.11)
average adult schooling (above 20 years)	0.00	-0.00	-0.26	-0.06
	(0.01)	(0.01)	(0.28)	(0.41)
dakar	-0.30***	-0.17	-13.88***	-15.64***
	(0.10)	(0.10)	(4.64)	(5.20)
other urban areas	-0.10	-0.07	-7.47***	-11.54***
	(0.07)	(0.08)	(2.83)	(3.53)
wealth	0.06**	0.07**	5.10***	4.93***
	(0.02)	(0.03)	(1.06)	(1.27)
household size	0.01	0.00	0.56**	0.24
	(0.01)	(0.02)	(0.23)	(0.32)
average adult age (above 20 years)	0.00	-0.00	-0.13	-0.06
	(0.01)	(0.01)	(0.13)	(0.13)
average adult employment (above 20 years)	0.07	-0.02	-6.36**	-8.62***
	(0.08)	(0.08)	(2.53)	(2.42)
no. of children	-0.00	0.01	-0.28	0.13
	(0.02)	(0.02)	(0.34)	(0.46)
constant	0.41**	0.47*	11.04	11.86
	(0.19)	(0.24)	(6.94)	(8.08)
observations	2,793	2,730	1,970	1,916
(pseudo) R-squared	0.16	0.16	0.07	0.07

Robust standard errors adjusted for clusters (districts) in parentheses: *** p<0.01, ** p<0.05, * p<0.1. The R-squared refers to columns (1) and (2). The Pseudo R-squared refers to columns (3) and (4).

Assessing the exogeneity of the instruments is more difficult as there are no tests that can clearly identify exogeneity. Moreover, the equations are exactly identified making it impossible to use standard exogeneity tests that rely on the assumption that at least one of the instruments is exogenous to assess the exogeneity of the others. In addition, it would not be clear how to implement such a test in the multi-step setting used in this analysis. Instead, we need to state clearly that the results shown below rest upon the assumption that migration

networks do not impact on educational attainment of children except through their effect on migration. However, if migrants provide educational goods such as schools in their home communities (see Chauvet et al., 2013), migration networks would not be truly exogenous and the effect of migration on child education may be overestimated. Similarly, the duration of migration of a migrant, once migrated, must not affect child education except through its impact on the size of remittances sent back home. Theoretically, migration rates may be higher where educational infrastructure is well-established and schooling levels are high as it may be easier for educated individuals to find migration opportunities. As the association between migration networks and household migration are also positive, the resulting estimate for migration may be overestimated. Similarly, the duration of migration may be positively related, in theory, if more schooling induces the migrant not to return for a longer period of time and to send home remittances for the schooling of the child. Therefore, the results below should be seen as initial empirical evidence for the relationships between migration, remittances and child schooling in Senegal.

Table 4.5 shows estimation results of the impact of migration, remittances and adult schooling on educational attainment of children aged 7 to 19. Columns (1) to (3) contain the results for boys. The first column includes migration and remittances as predictors for child education. Migration has a negative coefficient while remittances have a positive one. This is in line with the theoretical arguments if the negative effects of migration outweigh the positive ones leading to an overall negative coefficient. Remittances were expected to show a positive effect since they are supposed to alleviate credit constraints. However, both migration and remittances are not significant meaning that we cannot infer any negative or positive effect of these variables. In the second and the third column I estimate educational attainment using either migration only or remittances only. In this way the differences between the full

model and the models often used in the literature can be evaluated. It is notable that the coefficient of remittances, when included without controlling for migration, shows a negative sign while it shows a positive sign in the full model. Although this would confirm the theoretically expected result that the effect of remittances is overestimated if migration has a predominantly negative effect and is omitted from the regression, we cannot clearly infer this result from these estimations as the standard errors are very large and the effects are insignificant. Similarly, in the estimations of educational attainment of girls, the absolute size of the coefficient for remittances in the restricted model in column (6) is greater than that of the full model in column (4) since migration is likely to be responsible for parts of the effect. As the coefficient of remittances is negative, the results of the estimation including migration only (column 5) shows a greater negative coefficient. It is remarkable that the signs are negative for both migration and remittances in all estimations for girls. However, they do not exhibit a significant effect on educational attainment in any of the estimations.

Moreover, according to the theory, we would expect a positive impact of adult education on child schooling. This is strongly confirmed by the results of these estimations for both boys and girls. Specifically, an increase of average adult schooling in the household decreases the gap between the grade a child should be in according to her age and the grade she is actually in by about 0.33 in all estimations.

Going back to Figure 4 and revisiting the underlying theoretical relationships, we may conclude that Senegal indeed is located in area A, where preferred educational levels for children are lower than financial constraints. This means that remittances may not play a role for child schooling because the credit constraint is not binding. In contrast, there are many arguments that point to a positive or negative effect of migration, which should be visible in the absence of binding credit constraints. Therefore, it is likely that positive and negative

migration effects have cancelled out on average leading to a non-significant result in the estimation. Moreover, adult schooling appears to have a positive effect on child education as expected. These results are therefore in line with the theory if we perceive Senegal to be located in area A of Figure 4, which is likely to be the case given the low mean years of adult schooling as shown in Table 4.2. This result may therefore also hold for many other Sub-Saharan African countries with similarly low levels of adult schooling, such as Mali and Ethiopia.

Table 4.5: Impact of migration & remittances on child educational attainment – age 7-19

	(1)	(2)	(3)	(4)	(5)	(6)
		Boys			Girls	
migration	-1.09	-1.08		-3.30	-3.49	
	(1.38)	(1.36)		(2.53)	(2.45)	
remittances	0.00		-0.01	-0.02		-0.04
	(0.04)		(0.04)	(0.04)		(0.04)
average adult	0.33***	0.33***	0.33***	0.32***	0.32***	0.34***
schooling (above 20 years)	(0.06)	(0.06)	(0.06)	(0.09)	(0.09)	(0.07)
Dakar	1.12	1.12	1.48**	-0.55	-0.39	0.09
	(0.74)	(0.69)	(0.62)	(0.95)	(0.91)	(0.85)
other urban area	1.20	1.19*	1.30*	0.69	0.84	0.82
	(0.75)	(0.72)	(0.67)	(0.89)	(0.82)	(0.84)
wealth	-0.11	-0.11	-0.17	0.23	0.16	0.01
	(0.23)	(0.19)	(0.23)	(0.23)	(0.25)	(0.20)
household size	-0.00	-0.00	-0.03	0.14	0.14	0.09
	(0.08)	(0.08)	(0.07)	(0.16)	(0.16)	(0.08)
average adult age	0.03	0.03	0.02	0.06	0.06	0.03
(above 20 years)	(0.03)	(0.02)	(0.02)	(0.05)	(0.05)	(0.03)
average adult	-0.09	-0.09	-0.18	-0.39	-0.35	-0.42
employment (above 20 years)	(0.52)	(0.48)	(0.40)	(0.63)	(0.72)	(0.65)
no. of children	-0.02	-0.02	0.01	-0.20	-0.20	-0.17
	(0.11)	(0.11)	(0.09)	(0.20)	(0.20)	(0.14)
observations	2,765	2,765	2,765	2,693	2,693	2,693

Bootstrapped standard errors adjusted for clusters (districts) using 300 repetitions in parentheses: *** p<0.01, ** p<0.05, * p<0.1

In the next step, in line with the literature reviewed in section 4.2, I repeat the analysis for two age subgroups of children to see if these results differ depending on the age range of children. The first group contains children aged 7 to 12, that is the period in which they should be in primary school if they do not enroll late or retain a grade. Children in the second group are between 13 and 19 years old, the period they should be in secondary school (UNESCO-IBE, 2010). Tables G1 and G2 in the appendix show the results of these refined estimations. Similar to the results shown in Table 4.5, migration and remittances are insignificant predictors of educational attainment. Again, adult schooling is a highly significant predictor confirming the results obtained when all children were included.

To further investigate the reasons why both migration and remittances do not exhibit any significant effect for the data at hand, I will examine the impact of these variables on the household expenditure on education. The literature has argued that household investments in education are the main transmission channel through which migration and remittances may affect child education (e.g. Acosta, 2011, Cox-Edwards and Ureta, 2003). The correlation between remittances and expenditure for education is positive at about 13 percent. The correlation between remittances and the share of education expenditure in total expenditure is only around 1 percent. This may suggest that while the absolute value of the expenditure increases with remittances, its share of total expenditures remains roughly the same. However, these correlations do not account for other covariates. Table 4.6 shows instrumental variable estimations analogous to the ones in Table 4.5 using education expenditures as dependent variables.[52] The results for absolute and relative expenditures (columns 1 and 2) show positive coefficients for remittances and negative ones for migration. However, both coefficients are

[52] These estimations are on the household level. To allow appropriate comparisons to the previous estimations only households with children aged 7 to 19 are considered.

insignificant and therefore we cannot attribute a negative effect to migration or a positive one to remittances.

These results are in line with the expectations given the results for educational attainment: As neither migration nor remittances seem to influence the investment behavior of receiving households regarding education these variables also do not impact on child education. In contrast, adult schooling is a highly significant predictor of education investments (columns 1 and 2 in table 4.6) and therefore could be the main driving force of child educational outcomes through increased educational investments.

Table 4.6: Impact of migration & remittances on education expenditure

	(1) Absolute education expenditure	(2) Share of education expenditure
migration	-2,267.74	-1.60
	(2,199.31)	(1.42)
remittances	11.05	0.02
	(135.35)	(0.05)
average adult schooling (above 20 years)	303.61**	0.20***
	(128.28)	(0.06)
Dakar	321.03	-0.09
	(1,452.13)	(0.81)
other urban area	713.65	0.55
	(1,307.78)	(0.77)
wealth	1,551.24**	0.01
	(718.83)	(0.31)
household size	428.89**	0.04
	(177.44)	(0.12)
average adult age (above 20 years)	27.87	0.02
	(33.65)	(0.02)
average adult employment (above 20 years)	530.72	-0.51
	(664.95)	(0.47)
no. of children	-168.79	0.07
	(232.29)	(0.15)
observations	1,510	1,465

Bootstrapped standard errors adjusted for clusters (districts) using 300 repetitions in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table 4.7: Education expenditures & child educational attainment – age 7-19

	(1)	(2)	(3)	(4)
	Boys		Girls	
migration	-0.92	-0.73	-3.11	-3.08*
	(1.36)	(1.24)	(2.36)	(1.84)
remittances	0.01	0.01	-0.04	-0.03
	(0.03)	(0.04)	(0.05)	(0.04)
average adult schooling (above 20 years)	0.31***	0.30***	0.24***	0.23***
	(0.05)	(0.05)	(0.09)	(0.09)
education expenditure	0.00***	0.15***	0.00***	0.28***
	(0.00)	(0.05)	(0.00)	(0.07)
Dakar	1.13	1.20*	-0.72	-0.68
	(0.70)	(0.68)	(0.90)	(0.85)
other urban areas	1.14	1.29*	0.45	0.58
	(0.70)	(0.69)	(0.88)	(0.90)
no. of children	0.01	-0.03	-0.20	-0.25
	(0.11)	(0.10)	(0.19)	(0.17)
wealth	-0.26	-0.20	0.16	0.27
	(0.21)	(0.21)	(0.22)	(0.22)
household size	-0.05	-0.01	0.12	0.17
	(0.08)	(0.07)	(0.14)	(0.12)
average adult age (above 20 years)	0.02	0.03	0.05	0.05
	(0.03)	(0.03)	(0.04)	(0.04)
average adult employment (above 20 years)	-0.08	0.05	-0.49	-0.23
	(0.49)	(0.53)	(0.72)	(0.74)
observations	2,765	2,678	2,693	2,644

Bootstrapped standard errors adjusted for clusters (districts) using 300 repetitions in parentheses: *** p<0.01, ** p<0.05, * p<0.1. Absolute education expenditure is used in columns (1) and (3). The share of education expenditure in total expenditure is used in columns (2) and (4).

To find out, if education expenditures are indeed the relevant transmission channel, table 4.7 shows estimations including absolute and relative education expenditures besides migration, remittances and adult schooling to explain educational attainment for boys and girls. The education of adult household members still has a strong positive impact on child education. For boys the respective coefficients are similar in size and for girls the coefficients are smaller but nevertheless highly significant. Moreover, absolute and relative education expenditures have very significant positive effects on child educational attainment. This

suggests that adult schooling does not or only to a small extent have an impact on child education through education expenditures. These results suggest that more educated adult household members directly care for higher education of the household's children even when holding the expenditures for education constant. This may also be an indication that financial constraints are not binding and schooling levels of children can be increased if adults have favorable preferences towards education.

4.6 Conclusion

Migration and remittances flows in Sub-Saharan Africa are considerable and are likely to influence educational outcomes of children in migration households. The literature analyzing impacts on child education has produced ambiguous results and the dynamics in Sub-Saharan Africa have scarcely been researched. In this chapter, I contrast the various transmission channels both migration of household members and remittances migrants send back home may have on child education in sending households. I set up a model and illustrate that migration and remittances may have counteracting effects that need to be tackled in a unified framework including both variables. The model shows that the level of child schooling depends on their parents' preferences and financial constraints. Both are positively associated with the education level of parents. Remittances can further reduce liquidity constraints but the direction of the migration effect is unclear as there are a number of transmission mechanisms between migration and child schooling that can be positive or negative. Since existing studies have focused either on migration or on remittances but not on both simultaneously the interpretation of the resulting effects remained unclear.

Using survey data from Senegal, I operationalize the model including both migration and remittances as well as schooling of adult household members and estimate their impact on

child education. I address concerns of endogeneity using migration networks as instrument for the migration decision and the duration of migration of a migrant, once migrated, as an instrument for remittances.

The results of these estimations do not show any significant effects of migration or remittances on educational attainment of children aged 7 to 19. There is, however, suggestive evidence that the effect of remittances may be underestimated if migration is not controlled for and the effect of migration may be overestimated if included alone. This may serve to reinterpret the results of the existing literature. To investigate the reason for the lack of an effect I analyze the impact of both variables on the main transmission channel, education spending. As neither migration nor remittances appear to influence household spending behavior concerning education, the insignificant results with respect to child education are not surprising. Finally, in line with the theory, I find that average adult schooling is a highly significant predictor of education spending and educational attainment of children. It seems that educational preferences of adults essentially influence educational outcomes of children in Senegal. In contrast, preferred child education appears to be below the financially attainable level and positive migration effects cancel out negative ones leading to an insignificant overall effect of migration on child schooling.

Appendix G

Table G1: Impact of migration & remittances on child educational attainment – age 7-12

	(1)	(2)	(3)	(4)	(5)	(6)
		Boys			Girls	
migration	-0.48	-0.45		-0.97	-1.12	
	(1.29)	(1.34)		(6.38)	(6.35)	
remittances	0.00		0.00	-0.02		-0.02
	(0.02)		(0.02)	(0.02)		(0.02)
average adult schooling	0.20***	0.20***	0.21***	0.19**	0.20**	0.19***
(above 20 years)	(0.05)	(0.05)	(0.05)	(0.08)	(0.08)	(0.04)
Dakar	1.86**	1.84**	1.99***	1.18	1.35*	1.33***
	(0.80)	(0.75)	(0.58)	(0.84)	(0.80)	(0.41)
other urban area	1.69***	1.67***	1.72***	1.00*	1.14**	1.03***
	(0.49)	(0.45)	(0.42)	(0.58)	(0.55)	(0.30)
wealth	-0.13	-0.12	-0.16	-0.08	-0.15	-0.14
	(0.30)	(0.27)	(0.26)	(0.19)	(0.17)	(0.10)
household size	-0.01	-0.01	-0.02	0.03	0.03	0.02
	(0.05)	(0.05)	(0.04)	(0.41)	(0.41)	(0.05)
average adult age (above	0.00	0.00	-0.00	0.02	0.02	0.01
20 years)	(0.02)	(0.01)	(0.02)	(0.06)	(0.06)	(0.02)
average adult	0.01	-0.00	-0.06	-0.87	-0.76	-0.93**
employment (above 20	(0.34)	(0.33)	(0.36)	(0.61)	(0.60)	(0.42)
years)						
no. of children	0.01	0.01	0.02	-0.03	-0.02	-0.02
	(0.08)	(0.09)	(0.08)	(0.41)	(0.41)	(0.08)
observations	1,395	1,395	1,395	1,284	1,284	1,284

Bootstrapped standard errors adjusted for clusters (districts) using 300 repetitions in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table G2: Impact of migration & remittances on child educational attainment – age 13-19

	(1)	(2)	(3)	(4)	(5)	(6)
		Boys			Girls	
migration	-2.84	-2.92		-2.95	-2.65	
	(3.67)	(3.51)		(3.79)	(3.64)	
remittances	-0.01		-0.03	0.03		0.02
	(0.07)		(0.06)	(0.06)		(0.06)
average adult schooling	0.51***	0.51***	0.49***	0.49***	0.50***	0.54***
(above 20 years)	(0.10)	(0.10)	(0.08)	(0.14)	(0.13)	(0.11)
Dakar	1.29	1.34	2.35***	0.13	-0.15	0.80
	(1.76)	(1.69)	(0.89)	(1.49)	(1.43)	(1.11)
other urban area	1.86	1.90	2.20**	1.47	1.17	1.64
	(1.28)	(1.23)	(0.86)	(1.32)	(1.22)	(1.15)
wealth	-0.06	-0.09	-0.19	0.03	0.11	-0.17
	(0.37)	(0.33)	(0.26)	(0.43)	(0.44)	(0.29)
household size	0.07	0.06	-0.02	0.14	0.14	0.07
	(0.17)	(0.17)	(0.10)	(0.14)	(0.14)	(0.10)
average adult age (above	0.07	0.07	0.04	0.08	0.08	0.05
20 years)	(0.06)	(0.06)	(0.03)	(0.06)	(0.06)	(0.04)
average adult	-0.80	-0.76	-0.86	0.39	0.04	0.38
employment (above 20	(0.79)	(0.74)	(0.58)	(0.79)	(0.89)	(0.80)
years)						
no. of children	-0.14	-0.14	-0.03	-0.29	-0.29*	-0.25*
	(0.23)	(0.22)	(0.13)	(0.18)	(0.18)	(0.14)
observations	1,370	1,370	1,370	1,409	1,409	1,409

Bootstrapped standard errors adjusted for clusters (districts) using 300 repetitions in parentheses: *** p<0.01, ** p<0.05, * p<0.1

5 Concluding Remarks

This chapter concludes the dissertation, embedding the analyses in the development context regarding human capital, labor markets and remittances in Francophone Sub-Saharan Africa, highlighting the contributions of my analyses to research in these fields and suggesting future research that may benefit from the theories, empirical applications and results in this work.

In chapter 1, I introduced this dissertation remarking that the development of educational indicators (such as adult literacy rates) in Sub-Saharan Africa has been positive in the past years, nevertheless, still leaving considerable scope for improvement. However, since education is relevant for the labor market, the latter should be able to absorb higher numbers of students who graduate from primary or higher school. This does not seem to be the case: The labor markets in Sub-Saharan African countries appear to struggle with improved educational outcomes as the increase in wage employment cannot keep in step with increasing school enrolment numbers (see Bennell, 1996, p.188, Table 5). We would certainly not want to lower educational attainment to accommodate the specificities of the labor market but much rather improve the capacity of the labor market to offer decent employment options for an increasingly educated population. That is, there are two aims: First, further increasing the formation of human capital in schools and second, improving labor market options. This dissertation shows opportunities to improve both education and labor market outcomes in Sub-Saharan Africa by analysing the relevant dynamics which are summarized below.

As there are severe budget constraints in Sub-Saharan Africa, we could think of many educational improvements that may increase educational outcomes (such as the provision of text books or electrification of schools). I have chosen to study the consequences of grade retention as repetition rates are very high in Francophone Sub-Saharan Africa in comparison to other world regions and it appears to be a particularly expensive policy. Therefore, I have started my analysis of human capital on the level of students noting that grade retention can be costly to households who may need the labor of their children to sustain themselves and that high rates of grade retention is costly for governments as well.

I have used a unique panel data set from Senegalese primary schools (see PASEC, 2004) where comparable test scores across grades allowed a detailed analysis of the impact of grade repetition on student achievement. The methodological analyses include an innovative matching methodology that incorporates the development path of students, robustness checks and simulation estimates that give confidence in the results.

Greater achievement in response to grade retention could have justified wide-spread grade repetition practices in Francophone Sub-Saharan Africa. However, this analysis suggests that there is no evidence that grade retention positively affects subsequent student achievement and therefore that the costly practice of high repetition rates may be changed without a drop in student achievement measured by the test scores that students attain. To the contrary, the results indicate that grade retention may in fact worsen their achievement, potentially for de-motivational reasons.

Future research in the context of repetition and student achievement is highly dependent on high-quality data that are scarcely available in Sub-Saharan Africa. Of particular interest in this field is the high number of school dropouts. The discussion on selection in chapter 2 shows that research on dropouts is important if we want to learn more

about the consequences of repetition, the costs for governments and households and the potential of policies that try to minimize the number of students who leave school early.

If lowering grade retention rates indeed leads to better achievement and higher educational attainment of children, this will have consequences on the labor market. To understand what the consequences may be, I have introduced human capital considerations into the literature on remittances and labor market outcomes (chapter 3). Research on the relationship between the receipt of remittances of non-migrant household members and their labor market outcomes is ambiguous. The argument that remittances raise reservation wages and reduce labor supply is contrasted with research on return migrants who appear to use the capital they earn abroad to start a business in their origin countries. I construct a formal theoretical model that shows that both credit constraints and knowledge constraints need to be overcome to choose self-employment over wage employment. Remittances received would therefore not necessarily be used for consumption purposes but are used for potentially productive business start-ups if the educational minimum requirements are met by the respective individuals. Combining the remittances and return migration literature with human capital considerations seems a promising way of explaining the ambiguity of existing studies on remittances and labor supply.

In the empirical analysis, I used a detailed World Bank survey of Senegalese households from 2009 that was specifically designed to shed light on the issue of remittances (World Bank, 2009). The statistical analysis indeed provides evidence that remittances increase the likelihood of self-employment if individuals have spent at least one or more years in primary school enabling them to make simple calculations and to read. However, this result was only found for Senegalese men. Women did not seem to respond to remittances, which may partly be due to their traditional role in Senegalese society.

This has direct implications for future research: Empowerment of women in society may make the rationale of their labor market participation resemble that of men and therefore further research is needed to understand these dynamics for women. Moreover, these analyses are carried out in a setting of a low income country. With low literacy rates and low average years of schooling they are an example of the dynamics that are likely to be found in other Sub-Saharan African countries. To fully understand the importance of education in this context, studies on these relationships in higher income countries with more schooling is needed. Moreover, a data set that tracks households over many years and notes phases of unemployment, self-employment and wage employment as well as their financial constraints including the receipt of remittances would be highly useful to increase the precision of the results.

Combining the results of chapter 3 with the fact that an ever increasing number of children are enrolled in school and enter the labor market with higher levels of education, we may not be able to rely on increases in wage employment opportunities but may have to think about policies that support self-employment endeavors of individuals in order to take pressure from the labor market. As starting businesses often requires up-front costs and since remittances are not available to the entire population, the respective policies would have to target an improvement in access to credit markets. At the same time, this research also leads to the conclusion that individuals who face lower credit constraints may need to have at least a few years of education in a setting with scarce wage employment opportunities. Starting a self-employment project may be the only option for them to make a living.

Finally, chapter 4 contributes to the literature by specifically looking at the importance of credit constraints for the schooling decisions of households with respect to their children. In combination with the results of chapter 3, there is the possibility of a virtuous circle:

Remittances may potentially increase child education and higher educational attainment may lead to positive labor market outcomes later in life. Higher income from improved labor market choices could then increase the education of a new generation of children.

Specifically, the research aimed at showing that existing studies that analyze the relationship between remittances and child schooling are not only ambiguous but also do not offer clear interpretations of the identified effects. Remittances and migration are closely interlinked and net effects of one factor without the explicit consideration of the other factor are difficult to interpret. This research set out to disentangle the respective effects in order to understand how important the alleviation of liquidity constraints can be considered to be for educational outcomes of children. This research shows that neither migration nor remittances appear to be relevant for child schooling. Rather, child education may be best explained by the educational attainment of adults in the household. The estimations suggest that a higher average of adult schooling in the household increases educational attainment of children in that household beside its positive effect on education expenditure. This implies that for a low-income Sub-Saharan African country, it may not be binding credit constraints but rather the preferences of the adult population that prevent higher educational attainment of children. Therefore, a virtuous circle of increasing education induced by remittances could not be found. It is probably difficult to target parental preferences directly by means of policies. However, the reason why parents with lower education have a negative impact on their children's education may be that they do not believe the returns to education to be sufficiently high. This means that a policy that improves labor market conditions, such as increasing the number of wage employment opportunities or facilitating self-employment, may signal higher educational returns and may therefore indirectly lead parents to support their children's educational progress.

In further research, it would be useful to know, how much disentangling the effects of migration and remittances changes the results of existing studies, which would give us more information on the severity of liquidity constraints and the actual impact of the latter on the schooling decision of children. Much as in chapter 3, the results of these estimations can readily be transferred to other Sub-Saharan African countries with similar education levels and liquidity constraints. Further research, on countries with higher income and greater schooling levels, would help to understand the underlying dynamics of child schooling even better.

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